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DEVELOPMENT DIGEST

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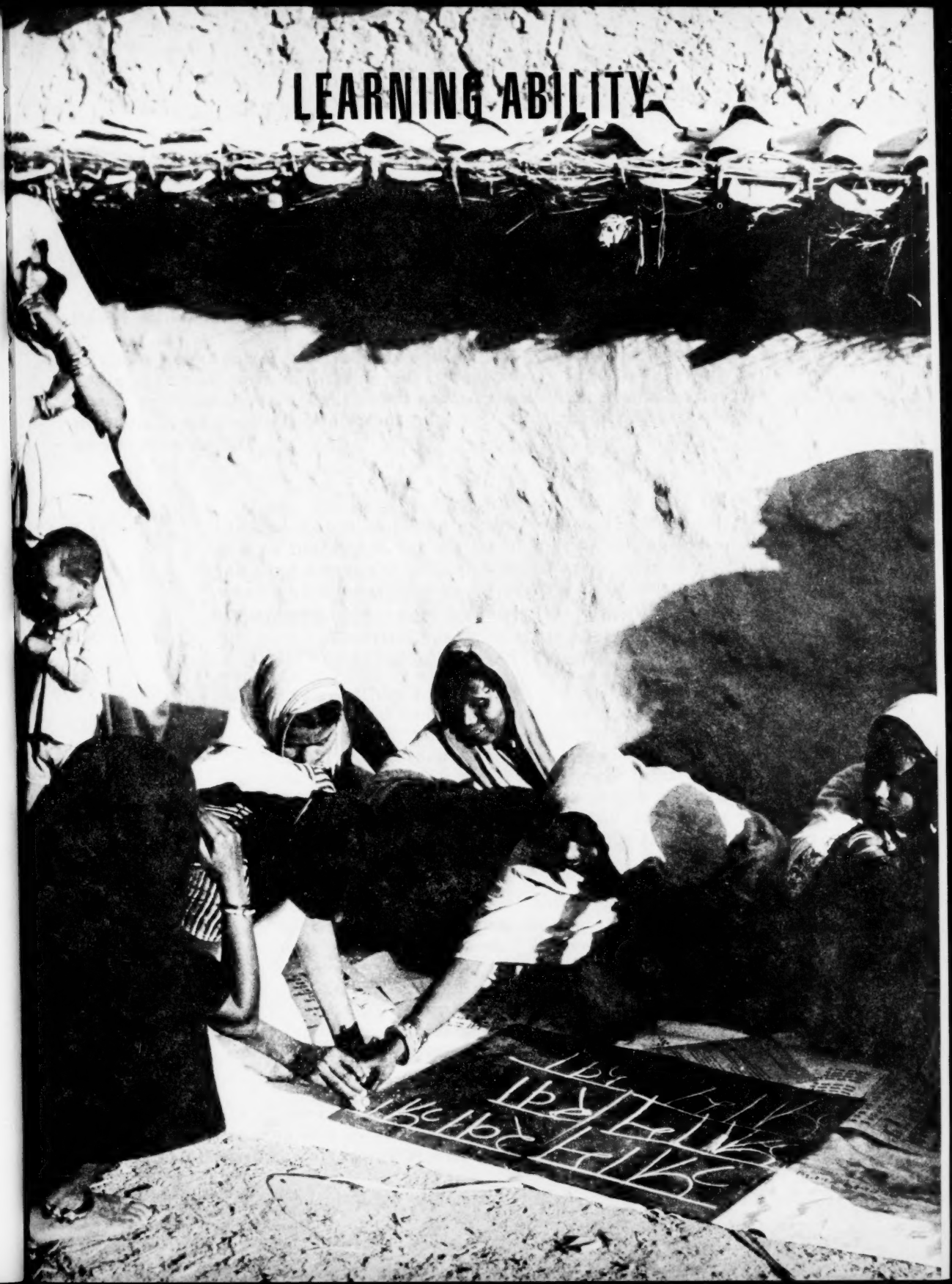
LEARNING ABILITY



INDIAN GIRLS LEARNING
TO WRITE, WITH THE TEACHER GUIDING
THE HAND OF A STUDENT.
(Photo: Ford Foundation)

Malnutrition and Brains

David A. Levitsky

[Recent research indicates that while malnutrition of infants affects brain size and growth, it may not permanently impair learning ability or emotional stability, which are more environmentally determined. Apparently these effects of early malnutrition can be overcome later in life.]

Juan, a small, puffy child, sits on the dirt floor of his one-room house in a rural village in Mexico. He stares blankly at the wall, no longer crying or complaining about the pain in his stomach. He is cold and weak and doesn't move. Although five years old, he is only three feet tall and weighs about thirty pounds.

Halfway across the country, five-year-old Jose runs with his friends to an open lot where they find an old junked car. They look inside. One boy discovers the latch to the hood and Jose opens the hood and peers curiously inside. He then slips down to look under the car. While his friend turns the steering wheel, Jose watches the rods push the front wheels from side to side; he traces the movement back to the steering wheel. Jose smiles, for now he has some understanding of how a car works. He cannot wait to tell his father and to come back to the lot the next day.

Juan, like the majority of children in the world, perhaps more than 400 million, suffers daily from the pangs of hunger and malnutrition. Worse yet, Juan's encounter with severe malnutrition may cause permanent damage to his brain, leaving him unable to ever reach his intellectual potential. Because of this possibility, many government officials, public health workers, physicians, nutritionists, psychologists, and other scientists have been

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working together to answer some basic questions concerning the long-term intellectual and behavioral consequences of childhood malnutrition. Does malnutrition produce permanent brain damage? Does malnutrition produce mental retardation? If malnutrition does affect intellectual development, what are the brain mechanisms responsible, and are the changes reversible?

Direct answers to these questions are difficult to determine and would require a rigorous scientific study, including long-term observation of children who are clinically malnourished and not receiving treatment. Clearly, such a study is, and must remain, ethically impossible. Although an indirect approach has limitations and requires considerably more effort to reach a sound conclusion than a direct one, we have learned a great deal not only about the long-term consequences of early malnutrition on cognitive development, but also about the brain's development, vulnerability, and functioning.

The idea that the brain may be affected by malnutrition is relatively recent. Early in the history of nutrition, at about the turn of this century, the brain was thought to be "spared" from nutritional insult. Scientists came to this conclusion because the brain, unlike other organs of the body, maintained its weight and composition during the course of nutrient insufficiency. Not until the early 1960s did scientists--working in South Africa and South America--find that children suffering from protein-calorie malnutrition showed signs of delayed cognitive development as measured by standard intelligence and developmental tests. Although the tests were refined to remove cultural bias, persistent lags in cognitive development prevailed in children who had suffered from early malnutrition.

Most noticeable was delayed language development. Age of speaking, vocabulary, and language organization are all deleteriously affected by protein-calorie malnutrition. Tied to retarded language development were delays in intersensory integration--the ability to pair a particular visual shape, such as a letter, with its particular sound. The development of intersensory integration is essential for learning to read. These studies, then, contradicted the earlier notion that the brain was spared from the deleterious effects of malnutrition. Behaviorally, these children showed the effects of malnutrition through alterations of brain function.

At about the same time, researchers working with laboratory animals found that the animal brain was indeed "vulnerable" to periods of severe malnutrition, particularly during the phase of rapid brain development--the first two or three years of life in a child or the first few weeks of life in the case of laboratory animals. They found that the brains of animals malnourished early in life were smaller and contained less DNA. Total DNA is taken as an index of the total number of cells of the brain. Most importantly, even following long periods of nutritional rehabilitation, the brain remained smaller and the DNA content lower.

Was this true also of humans? Unfortunately, it appears so. Children who have been malnourished show smaller brains and also displayed signs of retarded cognitive development as measured by various development tests. The next question, are these independent effects of malnutrition or does the physical change in the size of the brain produced by malnutrition cause the cognitive retardation, then became terribly important. If the brain is irreversibly altered by early malnutrition, then one must expect that generations of adults, perhaps entire societies, will perform at a suboptimum intellectual level. This would be catastrophic for developing countries trying to make technological leaps in a few decades and requiring highly specialized learning. These nations, of course, are the very ones suffering the ravages of malnutrition.

It thus became crucial to understand how malnutrition affects cognitive development. Since we cannot measure the biochemical and neurological events taking place in the brain of a developing child, we had to develop an animal model of cognitive development. At least in animals we can investigate the changes that take place in the brain during and following severe malnutrition.

But how was one to use the animal as a model for the cognitive development of humans? To study this question, Richard H. Barnes, a nutritionist working at Cornell University, brought together a number of psychologists, physiologists, biochemists, and nutritionists. The early findings of this multidisciplinary research group were clear. Rats subjected to severe protein-calorie restrictions early in life and then nutritionally rehabilitated over a period of several months still showed depressed performance in learning difficult discrimination problems. But the researchers, aware that many factors can affect learning performance and that differences in learning performance do not necessarily mean differences in the ability to learn, were cautious in interpreting their results.

When I joined Barnes's research staff in 1968, we conducted several studies that clearly showed that early malnutrition in rats and pigs increased their emotionality, again following nutritional rehabilitation. This is particularly true when the animal is placed in a situation that evokes an emotional response. Its reaction to a loud noise, a new environment, or a mild electric shock, for example, is greater than that of the well-nourished rat. The animal may squeal more, defecate or urinate, show reluctance to enter a novel environment or to return to one in which it was frightened.

This increased emotionality following malnutrition occurs in many different kinds of situations and in several different species, two factors that are crucial if we wish to use the laboratory animals as models for humans. The effects of malnutrition on behavior seem to hold for a variety of mammalian species, including rats, pigs, mice,

cats, dogs, and monkeys. Interestingly, protein-calorie malnourished children are also highly irritable and susceptible to temper tantrums.

But to return to our original question: does early malnutrition permanently impair the brain so that it cannot learn, that is, process cognitive information? In carefully controlled experiments neither we nor any other group has demonstrated any deficit in the ability of either a previously or currently malnourished animal to learn. Does that mean that early malnutrition does not affect cognitive development in animals or man? Not necessarily; it may mean that malnutrition affects cognitive development through mechanisms other than the ability to learn in typical learning situations.

As mentioned previously, one of the long-term behavioral effects of early malnutrition in animals is a heightened behavioral reaction in any emotion-evoking situation. Other conditions will produce similar effects, one of the most powerful being environmental isolation. Raising rats, mice, dogs, monkeys--or humans--in isolated environments produces long-term changes in behavior that can be observed in the adult. In all these cases there is an increase in behavioral reactivity to emotion-provoking events.

One explanation of this behavioral effect was offered by Ronald Malzack of McGill University, who theorized that the young mammal is continually learning about its environment in order to react appropriately to it. Our reaction to a novel stimulus is typically associated with an emotional response; we fear what we have never experienced. To the adult animal reared in isolation almost everything is novel, and hence it displays exaggerated emotional responses in far more situations.

What is important to us is the concept that the young organism is continually learning about its environment, not because the experimenter forces learning, but because it naturally occurs. Since the effects of early malnutrition and early emotional isolation produce similar behavioral effects, is it possible that both conditions, seemingly quite different, are operating through similar mechanisms?

In an experiment with rats, we raised groups for the first seven weeks of life under three sets of conditions: (1) standard laboratory environments; (2) environmentally restricted environments in which the animals were raised in small lightproof, soundproof chambers; and (3) environmentally "stimulating" environments in which the animals lived with littermates, were handled regularly, and had access to toys and other objects. In each of these three conditions there were two groups: one fed an excellent quality diet; the other maintained on a very low protein diet. Thus, all nutritional and environmental manipulations occurred during the first seven weeks of life. We then gave all animals a regular diet and placed them in standard environmental conditions for ten weeks before giving them a series of behavioral tests.

The results clearly showed the profound effect of early environment on many different behaviors. The previously malnourished animals were hyperexcitable, moved about in short, quick movements, were more aggressive, engaged in more fights, and were more reluctant to enter a large open area. More important, while early environmental isolation exaggerated these effects, environmental enrichment almost completely eliminated them. Poorly nourished animals raised in a stimulating environment tested almost as well as those that were well nourished.

These results raise some important questions concerning the mechanisms through which malnutrition may affect cognitive development. As far as can be determined, the effect of environment on brain growth is extremely small compared to the effect of early malnutrition. The brain size as well as total DNA content of the brains of all the malnourished animals were not significantly affected by environmental conditions, although their behavior was dramatically affected by their environment. Thus, even if malnutrition leads to the reduction in the size of the brain or possibly the number of neurons, this does not seem to be the major cause of the behavioral abnormalities.

This is not to say that the differences in behavior do not have a physical substrate in the brain. Indeed, there are differences in enzymes necessary for the metabolism of acetylcholine, a brain neurotransmitter, which correlate with the behavioral effects of the nutrition-environment interactions. Rather, the reduction in the brain size or total number of brain cells does not appear to be the critical variable in the production of behavioral abnormalities, and the ability of the animal to learn is not affected by severe malnutrition.

In order to reconcile these results and still explain the long-term behavioral abnormalities of animals malnourished early in life, we developed the concept of "functional isolation." The young organism is constantly learning information about its environment through play, curiosity, and exploration. This internally motivated curiosity to learn, however, is inhibited by malnutrition; the organism becomes "functionally isolated" from the acquisition of certain kinds of environmental information. Thus, malnutrition early in life may affect cognitive development, not by damaging the brain's capacity to learn, but by producing behaviors incompatible with normal environmental learning. The group of malnourished rats upon whom we "forced" environmental stimulation displayed only a minimal residual effect of malnutrition. When the information of the environment was minimal, however, malnourished animals were much more severely affected, behaviorally, than the well-nourished controls raised in isolation.

How does malnutrition "functionally isolate" the young organism from certain aspects of environmental information? One of the most obvious ways is the delay of psychomotor development. The young malnourished child or animal, late in developing the coordinated movement necessary

for crawling and walking, cannot explore its environment. Also, malnutrition restricts environmental learning through its action on the mother. Young rat pups that are malnourished either prenatally or postnatally are smaller and less developed in motor skills. The rat mother, reacting to these pups as if they were younger, has increased contact with them through the course of lactation. During the latter part of this period, pups normally attempt to leave the nest and explore their environment, but as a result of their smaller size, delays in their psychomotor development, and increased contact by the mother, such exploration is delayed.

These effects of malnutrition on the young and on the behavior of the mother also occur in humans. Dr. Alfonso Chavez of the National Institute of Nutrition in Mexico has studied the home environments in a rural Mexican village where the rate of malnutrition in children is quite high. Two groups of children were matched for physical, social, and economic characteristics of their parents. One group received a small food supplement, starting during the mother's pregnancy and continuing for the first three years of the child's life. During this time carefully trained observers, well acquainted with the villagers, went into the homes and studied the child and family for several days at a time throughout three years of the study.

The children receiving no supplemental food spent more time in the crib, slept more, spent less time out of the home, and were much more "attached" to their mothers than the supplemented group. The children receiving additional food, being more active, demanded more social interaction from the parents and siblings and thus induced an increase in the level of "cognitive stimulation" in the home.

Another mechanism through which malnutrition may affect cognitive development is through a depression in the young mammal's delightful curiosity. We are all aware of this behavior in the young puppy, kitten, or child. Parents know that a child may be getting sick because he is not as playful as usual. This playful curiosity is extremely susceptible to nutritional and physiological status; protein or calorie restriction profoundly alters the tendency of a young animal to explore a novel object placed in its environment. Experimenters have seen this with young rats, pigs, and monkeys, and clinicians frequently note it in malnourished children. While recuperating in hospitals, these children commonly sit quietly in the corner of a playroom filled with toys, rarely touching or trying to work any of them. They lack the curiosity-induced learning essential for environmental learning and for maximizing their cognitive potential.

These concepts help to explain a long-perplexing issue: why malnutrition has a greater effect on children from countries that are less technologically and economically developed than on those from affluent nations. In fact, studies of children from wealthy countries show no permanent effects of early malnutrition on cognitive development. During the Dutch famine winter of 1944/45, when the Germans blocked all

ports, many infants in the Netherlands were severely malnourished. Yet this did not adversely affect their intelligence, according to later studies. Similarly, a group of middle-class children studied in Boston, malnourished because they suffered from cystic fibrosis, which impairs nutrient absorption, did not show permanent signs of intellectual impairment.

The environmental setting of the children during the time they were malnourished is obviously important. Both the Dutch and Boston children were raised in highly educated societies. Even during the war years in Holland, there was strong emphasis on education. The Boston children did not suffer from a lack of intellectual stimulation. Like the laboratory situation in which the malnourished rats were forced into a stimulating environment, these societies encourage, indeed require, learning. They do not have to rely on endogenously motivated curiosity.

One of the most encouraging aspects of this problem is the possibility of rehabilitating the previously malnourished child. If the functional isolation model is correct, we are not talking about a permanently damaged brain or impaired ability to learn. Making the child well again should rekindle the curiosity to learn; at that time, he can begin to recover the accumulating store of cognitive information lost during the period of malnutrition. Myron Winick of Columbia University has recently accumulated some evidence to support this. Studying orphaned Korean children who were malnourished early in life, rehabilitated, then raised by American adoptive parents, he found no impairment in their IQs. Of course, "learning resources"--schools, teachers, books, involved parents, and a society that encourages learning--must also be available.

One cannot talk about malnutrition and intellectual development without talking about the total environment of poverty. The economics of poverty robs the child of good schools, attractive toys, libraries, books, and educationally stimulating environments. Poverty robs the parents of the time they can devote to playing with their children and "intellectually stimulating" them. But of all the ills of poverty, malnutrition is perhaps the cruelest, for it robs the child of one of the most precious characteristics of the young--and possibly one of the most important for the ultimate attainment of his intellectual potential--the hunger to learn.

[Extracted from "Ill-Nourished Brains," Natural History, Vol. 85, pp. 6-11, October 1976.

Pre-School Children and the Productivity of Education

Marcelo Selowsky

[If schools are to achieve high levels of productivity as their enrollments expand, it becomes increasingly important to build up "human capital" in the form of learning abilities of children before they enter school. Policies favoring breast feeding, child nutrition, and compensatory instruction are indicated.]

> "It is true that schools have "inputs" and "outputs", and that one of their nominal purposes is to take human "raw material" (i. e., children) and convert it into something more "valuable" (i. e., employable adults). Our research suggests, however, that the character of a school's output depends largely on a single input, namely the characteristics of the entering children. Everything else--the school budget, its policies, the characteristics of the teachers--is either secondary or completely irrelevant."
>
> Christopher Jencks

The relevance of preschool-age investment in human capital--both for the process of human capital formation in general and for formal schooling in particular--rests heavily on the following set of evidence:

1. The rate of enrollment in primary schools in less developed countries is accelerating, and this is drawing in an increasing number of children from lower-income families. The fraction of children from low-income families in elementary schools will increase over time.

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2. There is growing empirical evidence showing that preschool children from poorer segments of the population in developing countries have a lower performance record in most ability tests than children from higher-income groups. A large part of this evidence has been generated in medical studies attempting to isolate the effect of early malnutrition on mental development.

3. Recent findings in the field of education and psychology suggest that, although heredity explains an important fraction of children's intelligence scores, environment is nevertheless crucial in explaining these differences in test scores, and particularly the environment at early ages of life.

4. Early protein-type malnutrition--a phenomenon that characterizes a large fraction of children in developing countries--adversely affects mental performance as well as children's psychomotor activity. [See preceding article.]

5. Considerations 3 and 4 suggest that the determinants of low ability scores in preschool-age children could be influenced by public policy.

If we accept 1 and 2, then the elementary schooling system in developing countries will be facing an increasing deterioration of its entering "raw input" of preschool children. If the productivity of other school inputs (in the production of abilities, however defined) is largely dependent on the quality of that "raw input", this means that the future effects of schooling might be highly sensitive to present policies which have some effect on the qualities of the children when they enter school. Policies which would improve the learning potential of these children, and the costs of such policies could be regarded as preschool-age types of investment in human capital.

For economists, two interdependent questions would seem appropriate: First, to what extent are we overinvesting in schooling rather than in preschool-age types of human investment? Second, what are the types of investment in pre-school age children that can be influenced or manipulated by public policy, and what is the "productivity" of such investments?

Evidence concerning the Determinants of Preschool Ability Scores: The Non-genetic Determinants

General considerations. For our purposes, it is important to identify variables determining the level of ability the child has when he enters the school system, and to find which of these variables can be manipulated by policy instruments usually available to governments. The nongenetic variables are the ones which are most likely to fall

in this category. But what fraction of children's intelligence scores is explained by inheritance of genes from parents? This is an area of controversy in relation to findings in the Western societies. If similar studies were undertaken in developing countries, would they show a relatively higher explanatory power for variables other than the heredity variable--that is, for the nongenetic determinants? A probable hypothesis in this respect is that the range of variation in the nongenetic variables among children should be much larger for developing countries than the United States. If this is true, and if these variables do influence the level of intellectual ability (e. g. scores on IQ tests), the results obtained for the United States would not appropriately capture the relative explanatory power of the nongenetic variables vis-a-vis the heredity variable. For our purposes this is important: it means an increased relative importance of the explanatory variables that can be manipulated by public policy.

Is it worthwhile to disentangle the net effects of the different nongenetic variables to which low-income group children are exposed and which are contributing to low preschool ability scores? If it is true that children from lower income groups, who are subject to a "package" of nutrition, health, and environmental deprivations, score worse in ability tests, then why not directly change the whole package of these variables? Two kinds of considerations would reject such a view. First, some of the variables in that package are difficult to manipulate from an institutional point of view; and we do not know to what extent such variables are perhaps the "true" explanatory variables of children's performance. In this case, manipulating the rest of the package would not have a major effect on performance. Second, it is realistic to assume that the resources available for such public programs will be highly constrained, particularly because they involve sharp redistributive policies. In that case we are interested in identifying those variables which have the major impact per dollar spent in manipulating that variable; this requires estimates of the separate net impact of each manipulable variable.

We will now review some of the literature that gives information about the net effect of nongenetic variables.

The effect of early malnutrition. The causal hypothesis by which early malnutrition, especially a deficit in the intake of "high quality" proteins, affects mental functioning is basically a medical one: nutrient deficiency produces a damage in the central nervous system because early brain growth is largely a process of protein synthesis. This has been confirmed in experiments with animals and by preliminary findings of reductions in the number of brain cells in dead children who suffered severe malnutrition. Some particular types of abilities that seem to be affected by malnutrition appear to be crucial for further learning; if this is true, early malnutrition would condition the effectiveness of school inputs at later ages. In addition, there is

some evidence showing that infectious diseases are likely to be less severe and less frequent in well nourished children. To the extent an infectious disease affects the child's responsiveness to his environment it affects his cognitive development.

Apathetic behavior has been one of the most clear effects of malnutrition in almost all studies. Cravioto and DeLicardie have an interesting hypothesis about the further effects of apathy: "It should be recognized that the mother's response to the infant is to a considerable degree a function of the child's own characteristic of reactivity. . . Apathetic behavior in its turn can reduce the value of the child as a stimulus and diminish the adult's responsiveness to him. Thus, apathy can provoke apathy and so contribute to a cumulative pattern of reduced adult-child interaction."

The effect of early environment. This is a difficult subject to summarize, since a great deal has been written and there are numerous contradictory interpretations of the same data. Little research has been done in this area in developing countries; most of it is in developed countries--particularly the United States. We can distinguish two types of environment the child is exposed to at preschool age: home environment, and out-of-home environment. The policy options are to change the quality of both types of environment, or change the "mix", i. e. to change the fraction of time the child is exposed to a particular environment.

The best examples of changing the out-of-home environment are the large-scale programs of preschool compensatory education (between ages 3 and 5) undertaken in the United States, particularly the Head Start program. Preliminary findings concerning these large-scale compensatory programs have not been encouraging. This has led researchers into two new areas of study: First, to determine to what extent such findings are a result of the failure of such programs to adapt themselves to the characteristics of disadvantaged children. Some features of the Head Start program were based on the nursery and kindergarten model originally adopted by high-income families, and whose aim was "free play." In this respect it is relevant to quote J. M. Hunt: "Head Start is not synonymous with compensatory education. Compensatory education has not failed. Investigations of compensatory education have now shown that a traditional play school has little to offer the children of the poor. But programs which made an effort to inculcate cognitive skills, language skills and number skills, whether they be taught directly or incorporated into games, show fair success."

The second line of research stresses that current compensatory programs may start too late, in the sense that the child by age 3 or 4 has already been conditioned by the environmental deficits in the family. However, there are probably some limits to the minimum

age a child can be physically withdrawn from the family in order to be exposed to an institutionalized program, which would constrain the potential use of such findings in generalized policy making.

Research undertaken in Cali, Colombia has attempted to identify the types of intervention, including nutritional supplementation as well as behavioral stimulation, that are necessary to overcome specific mental deficits in preschool children (age 3) from the lowest economic level families of that city. The importance of this research stems from the facts that: (a) The children analyzed are not characterized by extreme malnutrition, the kind of cases usually studied in the "pure malnutrition studies"; they tend to represent a more typical situation of low income families in urban areas, and therefore more relevant for our purposes. (b) Particular emphasis is being given to analyze the separate effect of particular types of stimulation interventions on specific mental tasks of the child relevant for further learning. Their preliminary findings showed that particular stimulation and nutritional interventions at age 3 can raise certain mental capabilities over and above the performance of well-nourished children from similar income groups.

Home environment before age 3. Concerning the effects of different rearing practices and different mother-child interactions before age 3, we may quote J. Kagan: "A final strategy, not exclusive of the first two (school and preschool years 2 1/2 to 5), is to change the mother's relationship with her infant. The idea for this suggestion rests on the assumption that a child's experience with his adult caretaker during the first 24 months of life are major determinants of the quality of his motivation, expectancy of success, and cognitive abilities during the school years." In an experiment with 140 infants of different socio-economic classes, Kagan found significant differences in fixation time, vocalization, and fear. In another experiment 60 ten-month-old girls from two different socio-economic groups were studied. The families were visited and the child-mother interactions were recorded. In the higher socio-economic group the mother "spent more time in face-to-face posture, more time talking to her and issued more distinctive vocalization to the infant. They were more likely to entertain their children with objects, to encourage walking and to reward them for mastery." Behavior of the infants at the laboratory showed that those belonging to the upper group were better able to differentiate meaningful from nonmeaningful speech and its source. At the same time they showed a stronger will to resolve the discrepancy of acoustic differences between different voices.

Where Do We Go From Here?

The research implications for developing countries of some of the above hypotheses are enormous; however, some priorities and prob-

lems ought to be pointed out. Much more information is needed concerning child capabilities in developing countries. Three questions concerning the levels of abilities of entering students seem important for further exploration:

1. How large are the differences in child abilities among socio-economic and ethnic groups on a country-wide basis? Up to now this information has been obtained through isolated samples, by a variety of scientists of different disciplines, with results that are hard to compare and aggregate. Is it possible to institutionalize a generalized common test of abilities to be administered, in groups and by the same schools, to entering children? What are the relevant questions to be asked in these tests? What can educators suggest in this respect?

2. What are the socio-economic and ethnic groups that, in a particular country, will be incorporated into the elementary schooling system during the next decade?

3. If it is true that the level of ability of children entering school will be changing, what are the implications for changes in the quality and types of school inputs? Would certain types of school inputs, such as compensatory education for selected groups or individuals, be more productive than other inputs?

Policies to change the out-of-home environment through wide scale preschool compensatory programs would seem difficult to undertake in the short run, unless we think of those programs as simple extensions of the existing elementary schooling system to merely bring children one or two years earlier into kindergarten programs. However, the United States' experience has shown that simple extensions of the "kindergarten type" are not sufficient or properly designed to compensate for the environmental deprivation low income children have already suffered. A much more complex type of program appears to be required. It is pertinent to this question to note that lower income children tend to enter primary schools at a later age (1-3 years later) than higher income students. This evidence is at least clear for Latin America. An important research topic in this area is to study what determines the parents' decision concerning the age at which they send their children for the first time to school.

How can we use the logistics of the existing education system to affect the determinants of ability that take place at home before age 3? In the short run, educational programs for young women concerning child rearing practices would provide one type of solution. From our earlier analysis two types of educational program --with clear research implications for their proper design--appear to be

important. First, nutrition education, particularly with respect to infant feeding and breast-feeding practices. There is growing evidence that the decline in breast-feeding practices in low-income families of urban areas is a main determinant of infant malnutrition. [See Development Digest, Jan. 1978, p. 26.] This is an important area to be researched: what determines the length of breast-feeding, and how could it be lengthened through educational programs?

Second, education on child rearing practices with particular emphasis on early stimulation seems another course of action. Educational programs concerning this issue involve some preliminary research which, to my knowledge, has not taken place on a wide scale in developing countries. How different are child rearing practices among families in developing countries? What are the factors determining these differences? Are they related to income groups or to particular ethnic groups of the population?

Academic Achievement and School Environments in Uganda

Stephen P. Heyneman

[The primary school leaving examination results in Uganda revealed an unexpected trend: average scores were higher in the more isolated, low income, rural communities than in schools of the more urban and wealthy areas. The apparent reason is a higher selectivity of students in the former.]

From teachers in East Africa, as elsewhere, it is common to hear that children raised in industrial urban areas are at an academic advantage. Through their daily experiences, these children, so the theory goes, have more opportunities to learn from their communities. Children who have actually seen tall office buildings, elevators, traffic lights, supermarkets, factories, and airplanes, and who have talked to foreigners, presumably have some advantage in learning tasks that the academic curriculum requires, that is, a rather sophisticated awareness of economic geography, history, the English language, and mathematics.

To test this assumption in Uganda, this study took the Primary Leaving Examination (PLE) scores from a random sample of 67 schools in 5 economically diverse districts (North and South Karamoja, West Buganda, Bugisu, and Toro) and the 3 largest urban areas in Uganda (Kampala/Entebbe, Mbale/Tororo, and Jinja). These schools represented 10.7 percent of all the schools and 12.6 percent of all the pupils from the sample districts. Schools in the sample were first categorized as urban, semirural, and rural. Those schools located within a town of 10,000 or more people were defined as "urban" (one school in Jinja, three in Mbale, and eight in Kampala). Schools situated within

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a ten-mile radius of a town of 10,000 (a bicycle-commuting distance) were defined as "semirural"; this group was comprised of 16 schools. Schools situated more than the 10-mile radius from a town were designated "rural"; 39 schools fell into this last category.

Children in urban schools might have been expected to score higher than those in semirural ones, and those in semirural schools higher than those in rural schools. The opposite, however, proved to be the case. Mean achievement on the PLE was highest (153.8) in rural schools; semirural schools ranked next (147.7); while urban schools averaged the lowest (139.1). Moreover, this pattern was not limited to 1972. Examination scores of the sample schools for the previous year yielded similar results, with the average urban school scoring 141.3, the semirural 150.0, and the rural 150.3.

Population Density and Proximity to a Paved Road. Density of population and the proximity to a paved road may be interpreted as measures of potential communication. Greater diffusion of ideas, inventions, information, and knowledge of the "outside" world generally occurs in communities where people live close to each other. Similarly, the proximity to fast and efficient flow of goods and services, newspapers, letters, travelers, and other messengers can broaden the outlook of the inhabitants of an otherwise isolated community. Thus, because much knowledge still passes by word of mouth, it was thought that these two measures would show significant positive associations with a school's performance on the PLE. For this reason the negative correlations of - 0.305 ($p=0.02$) between school achievement and population density, and - 0.292 ($p=0.02$) between achievement and the distance from a paved road, were somewhat startling. Furthermore, when urban schools were excluded, and the characteristics of only rural and semirural schools were processed, any remaining preconceptions were shaken, for these relationships remained negative and statistically significant - 0.286 ($p=0.04$) and - 0.202 ($p=0.05$). This seems to suggest that levels of student achievement actually increased the further a school was situated from a paved road and the lower the local density of population.

Community Wealth. Each year all adult males out of school and every head of household are assessed for tax purposes by a village headman, an official who has considerable administrative responsibility. Based upon guidelines established for each district he must place taxpayers into one of 17 tax liability categories which range from 40 to 600 shillings per year (US$4.80 to $72.00). Out of 17 brackets, for example, a majority of the Toro district taxpayers were assessed into either the 60 or the 70 shilling category. An unusually impoverished household would be assessed at less than 60 shillings per year. The proportion of households in a community assessed in excess of 70 shillings per year was, therefore, taken as representing those adults with better than subsistence economic status.

Both the per capita collected revenue in a community, and the proportions paying over 70 shillings per year, were negatively correlated with school achievement averages in communities. The proportion coefficient was the stronger at - 0.436 (p=0.001), but per capita level was significant nonetheless at - 0.292 (p=0.02). There is something surprising and consistent in the above findings. Although there have been reports before of weakly negative or zero correlations between the wealth of a nation and mathematics achievement, consistently significant correlations were not expected. We found rural schools, especially those situated in areas of low population density, tending to perform better than schools in areas of high population density; schools farther away from paved roads scoring better than those near paved roads; and schools in communities with low per capita incomes and low percentages of wealthy taxpayers scoring higher than those in communities with high per capita incomes and higher percentages of wealthy taxpayers. This was precisely the opposite of what had been expected. The question now remains as to why these schools in isolated, less populated, economically impoverished areas tended to score better than the others.

Characteristics of Children in the Most Isolated Schools

An examination of the children enrolled in the most isolated schools suggests three possible reasons why they perform better: their age at the time of sitting for the PLE, their rate of examination repetition, and their preselectivity based upon the scarcity of primary school places in their local communities.

Maturity. Conditions force children in the most isolated, sparsely populated, underdeveloped areas to start school later, and if they leave school temporarily, to return after having stayed away longer.

Exam Repetition. In addition, the frequency with which pupils repeated the examination was two or three times higher in the most isolated schools. A fifth of the rural pupils in North Karamoja and fully 40 percent of those in South Karamoja confirmed that they had repeated, compared to 5.4 percent and 7.5 percent in the more urban Toro and Bugisu Districts. Naturally those who repeated the examination also tended to be older, and repeating once did affect scores. Those 295 individuals who reported having repeated once scored an average of 10 points above those who said they had never repeated. This factor thus appears to have affected scores in those areas where illegal repeating was most prevalent. Repeating more than once, however, did not result in greater success: the scores of those who reported having repeated the exam more than once did not differ from those who had never repeated the exam at all. Furthermore, though children in the four most isolated schools tended to be older and more apt to have repeated the examination, the correlations between these variables and individual performance (0.006 and - 0.01) indicate a lack of association within the schools. Lastly, neither repeating nor age could be identified as a principal reason for the success of isolated

schools because the capital city of Kampala, whose rate of repetition and average age for examinees were both higher than in all but one district, scored the lowest of all sample districts.

Spatial Distribution of Schools. In the more isolated, rural areas there are fewer schools in proportion to population. Spatial distribution is linked with equality of educational opportunity in two ways: first, it can be assumed there are fewer opportunities for schooling in the communities which are less developed economically and more isolated. Second, in communities where educational opportunities are limited, the kind of children who do enter and who do remain in school are less typical. In other words, in areas with less opportunity for schooling, the 7th grade students are less representative of their age cohort than are those who are found in grade 7 in areas where school attendance is more nearly universal.

It appears that in areas lacking in opportunity for schooling, the selectivity of those who do go to school distinguishes them in some way from pupils in areas where opportunity is more widespread and entry is easier. Similarly, when schooling is not free, the most impoverished among those who wish their children to attend are forced to select more carefully. For them, a dropout or an examination failure would result in a loss of investment more serious than in communities where schooling is taken as the norm. In more isolated and impoverished areas the more able pupils may be the first to attend because they are deemed the soundest investment.

School Access and Ethnic Differences. Knowing that schools and pupils from the most impoverished and isolated communities outperformed others might raise questions as to whether this situation was attributable solely to community selectivity, or whether this situation was due to a systematic distinction among ethnic groups expressing itself in cognitive performance. There were eight groups from whose areas schools were chosen: the Bakonjo, Bawamba, Labwor, Pokot, Karamojong, Batoro, Bagisu, and Baganda. These groups are linguistically and culturally distinct.

First, one might ask which ethnic group had the first experiences in school. In Africa, where schooling is of such crucial importance in the labor market, the group with the first experiences might be expected to "get the jump" on the others, to be more used to schools and testing, and perhaps to be more achievement-oriented in general. In fact the opposite was true. Schools in Uganda were established first in the areas of the Baganda and second, from the sample, in the areas of the Batoro and Bagisu, groups which scored relatively low on average. Schools have only recently been established in the areas of the highest-scoring ethnic groups, often taking several generations for the diffusion.

Second, one might ask whether traditional cultural differences among ethnic groups could explain the pattern of high scores to be

found in isolated areas. Knowing that children from ethnic groups with centralized tribal political structures have moved upward occupationally out of proportion to their number in areas of Ghana, western Nigeria, and southern Uganda, for example, one might reasonably wonder if the present offspring of these pre-colonial, powerful political empires wouldn't manifest their aggressive success of old in the realm of academic performance. If they do, however, it is not evident after the differing patterns of attendance have taken their effect. Of the Ugandan children who reached grade 7, the two worst performing groups (the Baganda and the Batoro) were those who would be considered the offspring of the old political kingdoms, a result opposite to what might have been expected. Similarly, it adds little to our understanding of differences in group performance to distinguish between traditional pastoral and agricultural groups. This suggests that when one asks the question as to why children in the more isolated areas appear to perform better on standardized tests, one would be more likely to find the answer by asking what percentage of the age cohort was in school from the local community than by asking to which ethnic group a child happened to be affiliated.

In sum, what all this suggests is that when a higher proportion of an age cohort can attend school, one might expect the average academic level to diminish by some amount. In no way does this imply, however, that the quality of education transmitted by the schools has declined. What this means for providing equal educational opportunity is that scholars, planners, and administrators should not assume that isolated and impoverished schools are automatically the most underprivileged; for by having to educate a smaller percentage of the community's children, they may in fact have been given a higher quality of pupil-material with which to work.

[Extracted from "Relationships between the Primary School Community and Academic Achievement", The Journal of Developing Areas, Vol. 11, Number 2, January 1977, pp. 245-259.

Birth Order and Intellectual Development

Daniel J. Davis, Sorel Cahan,
and Joseph Bashi

[The tendency for birth order to affect intelligence test results and school performance has been noted, largely in Western societies. Generally the first born tends to do best, the next born next, etc. ; the main reason is thought to be that the first child gets greatest attention and stimulus from the parents, while later children must share this attention with more and more siblings. However, test scores on a large number of Israeli eighth grade students of Asian-African origin showed that in large families the later born children tend to perform better. This article considers these findings in the wider national context, and suggests that relatively low educational levels of parents combined with universal schooling may be the explanation.]

Using test performance on Dutch army recruits, Zajonc and Markus have formulated a model that relates intellectual development to birth order and family size. The model defines intellectual environment in the home as the average of the absolute intellectual levels (that is, "mental age" rather than intelligence quotient) of all the inhabitants. The intellectual development of each child is affected by this intellectual environment. According to the model, family size has an effect on the family average because in larger families a greater proportion of the inhabitants are at lower intellectual levels (being young). The effects of birth order result from the growth of later-born children in an environment that reflects the relatively low intellectual levels of their older siblings. However, the decreasing performance for later-born children in large families can be reversed as older children mature and provide them with a richer environment.

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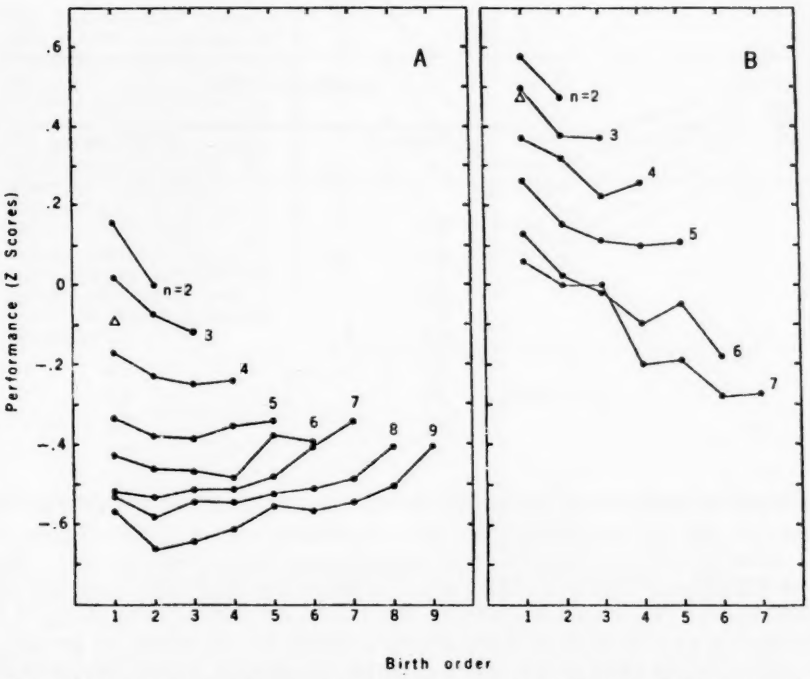

Fig. 1. Mathematics test performance (in z scores) at age 14 as a function of birth order and family size (number of children, n). For Δ, $n = 1$. (A) Israeli students of Asian-African origin, born between 1951 and 1956 ($N = 109,304$). (B) Israeli students of European-American origin, born between 1951 and 1956 ($N = 82,689$).

We now present achievement test data of eighth-grade Israeli students as a function of birth order and family size (Figure 1). The data are based on a standard achievement test given to all eighth-grade elementary school students in Israel. These results are from the arithmetic computation and problem-solving subtests for 191,993 children tested in the years 1966 to 1970 (only one child per family is represented in the sample). The results are presented separately for students whose fathers immigrated from Europe, America, South Africa, and Australia (N = 82,689) shown in Chart B, and for students whose fathers immigrated from Middle Eastern and North African countries (N = 109,302) in Chart A. The differences in mothers' educational levels are shown in Table 1.

According to the Zajonc and Markus confluence model, decreasing performance as a function of birth order is arrested and reversed when older children in the family have matured enough to give the later-born children a relatively rich intellectual environment. The birth-order rank at which the reversal occurs depends on two factors: the rate of intellectual development, and the size of birth intervals. Greater developmental rates and larger intervals both lead to a reversal at earlier

Table 1. Mothers with some formal education as a function of family size (number of children) and subpopulation.

Family size	Mothers (%)	
	Oriental	Western
1	64	98
2	81	99
3	76	98
4	63	95
5	50	91
6	40	86
7	35	83
8	32	78
9	28	77

birth order ranks. In order for this explanation to hold true for the results shown in Fig. 1, two conditions must be met. (i) Within the Israeli-Oriental sample, birth intervals must be greater in large families; and (ii) in large families, birth intervals must be greater in the Oriental than in the Western sample. Although we have no direct data, it is unlikely that either of these two conditions is met. In addition, it is unlikely that Oriental children develop more quickly than Western children, or that Oriental children in large families develop more quickly than those in small families.

The inability of birth interval or developmental rate differences to explain the results led us to consider parents' intellectual levels. In large families of very high intellectual level, it is not likely that older children will have developed to the point at which they contribute more than their parents to the intellectual environment of the home. However, in large families with parents of very low intellectual level, and where children are learning outside the home, it is likely that older siblings will contribute more than the parents at a relatively early age.

If this is correct we would expect two different patterns of intellectual environment as a function of birth order in these two cases. The first case, of the well educated family, would lead to decreasing intellectual environments as a function of birth order: the richest environments would be enjoyed by the first two or three children. The second case, of a less educated family, would lead to a slight decrease in intellectual environments at the early birth ranks, with an upswing for the later born: the richest environments would be enjoyed by last-born children.

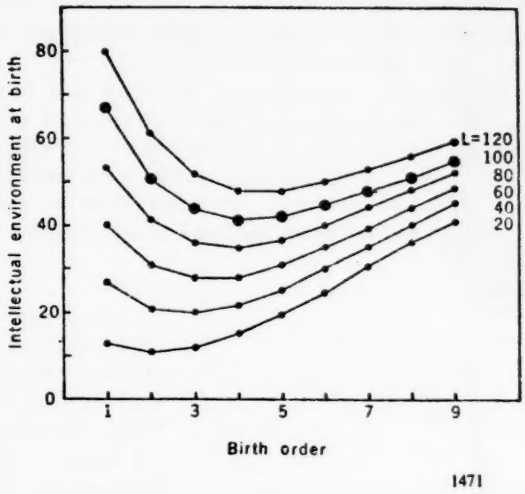

Fig. 2. Intellectual environment at birth as a function of birth order for different values of parents' intellectual level (L) under the assumptions of a 2-year gap, a time constant of 0.1, and that children develop to an intellectual level of 100. Therefore, the absolute intellectual level of a child is $100(1 - e^{-0.1t})$ where t is age in years. The curve marked by large circles indicates that the parents' intellectual level is equal to those of their children at maturity.

By varying the intellectual levels of parents relative to those of their older children, the two patterns can be predicted by the confluence model. Using the same assumptions and procedure but with varying values of parents' intellectual levels, we obtained the pattern in Fig. 2. As the parents' intellectual levels decrease, there are two important changes in the curve of intellectual environment at birth as a function of birth order: (i) The environment starts to increase sooner, and (ii) the intellectual environments of later-born children surpass those of early-born children. These are the two features evident in the Israeli-Oriental achievement curves for different family sizes. Therefore, if the parents' intellectual levels in large Israeli-Oriental families are generally below those of older siblings, and if this is not the case in small Israeli-Oriental families or in Israeli-Western families, the pattern of results can be predicted by the confluence model.

Large and small Israeli-Oriental families differ in the percentage of mothers with some formal education (Table 1). More important, since school attendence was compulsory until the eighth grade, older children in the large families may soon have surpassed their parents in their ability to educate and help the younger children in the family. This hypothesis is verified by data from questionnaires obtained from a representative sample of 4321 Israeli sixth-grade children in 1973. With the number of older children held constant and with decreasing formal education for the parents, children are more likely to report that an older sibling rather than a parent helps with homework and takes an interest in school activities. For example, when the child has two older siblings and neither parent has formal schooling, about 88 percent report that an older sibling rather than a parent helps with homework. The corresponding figure when at least one parent studied beyond high school is 31 percent.

A process by which children overtake their parents in providing intellectual stimulation for younger siblings can be described by this model. An alternative approach would view intellectual development as a function of the external as well as the home environment. This approach does not contradict the model but adds a component of intellectual development that is independent of the intellectual environment of the home. This component should be particularly evident in rapidly developing cultural groups, or societies in which educational institutions provide greater intellectual stimulation than parents do.

[Extracted from "Birth Order and Intellectual Development: The Confluence Model in the Light of Cross-Cultural Evidence", Science Vol. 196, Number 4297, pp. 1470-1472, 24 June 1977, Copyright © by the American Association for the Advancement of Science, Washington, D. C.]


DATA COLLECTION

TWO FARMERS BEING INTERVIEWED IN LASKAR GAH, HELMAND PROVINCE AFGHANISTAN. (Source: Kay Muldoon for IDA)

Statistical Development

S. S. Zarkovich

[The development of a nation's capability for collecting statistical data with appropriate accuracy, speed, and at a reasonable cost requires a lengthy evolution. Some basic problems encountered in this process are discussed. The author speaks from his experience in technical assistance, with particular emphasis on agricultural statistics.]

Methods and Approaches

Post-war political events have had considerable bearing on the development of statistics, principally with the sudden appearance of many new states on the political stage and the great weight assigned the social and economic problems of these countries. In the first years after the war the range of data needed was restricted to basic characteristics such as the number of people, age and sex distributions, areas and production of certain crops, livestock numbers, etc. However, it was difficult to get even that much. The education of people in many of the countries involved was below the level needed for successful cooperation with statistics collectors. Besides, statistical offices did not exist in many countries; technical staff and facilities for data collection were missing; resources were meager, etc.

In this situation the appearance of sampling methods helped to achieve a really major breakthrough. The use of sampling has made possible data collection even in countries where the conditions for statistical work were most difficult. It was a way to bypass a variety of difficulties and achieve reasonable accuracy rapidly no matter how unaware the population was of statistical units. In fact, the procedures of physical measurement,

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such as crop cutting in the estimation of yield, measurement of areas in area statistics, weighing in yield and food consumption surveys, counting of units in fruit and other types of surveys developed rapidly and found their application even in the least developed countries.

The progress achieved in the collection of data has led to a considerable popularity for sampling, which gained the reputation of an extremely flexible tool that can easily fit the conditions of any country and particularly of the less developed ones. Wherever a new statistical office was established the main emphasis became the taking of sample surveys.

Increased needs for data. This beginning period of clear ideas about the development of statistics did not last very long. As preparation started of elaborate programs for economic and social development, the needs for statistical data increased. In agricultural statistics, for example, data on production available only at intervals of several years did not satisfy the new needs. Planning agencies insisted on current statistics, viz. annual information about crop areas and crop production, livestock, animal production, fertilizers, prices, seasonal variations of prices, utilization of food, etc. In this new situation the statistical offices were unable to meet the requests coming from government agencies. Their principal means was sampling, which was adequate for occasional surveys, but not more than one or two surveys could be taken in a year. Under the new conditions a number of area surveys were needed each year. For each of them cars were necessary to transport the staff. This staff had to be equipped with measuring instruments. They had to be highly trained, as the measurement of fields assumed an understanding of geometry. There was also a need for a strong central office where all the area calculations would be carried out, and bulky supervisory machinery was equally indispensable. The same was true of yield surveys, which needed transport, equipment, sacks for crop weighing, threshing, drying, etc. Such surveys had to be repeated several times a year in order to have at least the most important crops covered adequately.

The resources available to governments were in many cases hardly sufficient for a couple of sample surveys a year. The statistical offices became aware of their inability to keep pace with the increasing demand for data. When other government agencies and other users of data realized that they did not get from statistical offices what they needed, they started thinking of ways and means of meeting their needs by themselves, independently of the statistical offices. Big agencies, particularly those responsible for planning, started their own statistical production, and in some countries developed into parallel statistical offices. Very soon some of these offices acquired the reputation of being the only real source of data, and the official statistical offices sometimes seemed unable to justify their existence. All the problems described are appearing on a much larger scale in recent years. The needs of the users of data, particularly governments, have continued to grow.

Approach to statistical development. In this situation the question arises: should statistical offices confine their work exclusively to what can be achieved with the help of well established scientific procedures? If this view is accepted, other methods of collecting data, such as eye estimates and various guesses should not be used, and the statistical offices therefore have to neglect needs for data which lead to non-scientific practices. The consequences of such an attitude are, as noted, a decline in the position of these offices.

A more realistic view of statistical development is suggested by the history of the present developed countries. In these countries the collection of data started in the form of occasional surveys carried out through the administrative machinery. Officials in the lowest administrative units, such as counties or communes, had to provide the requested estimates for all their territory. This is also the early form of censuses and current statistics: data were collected in the beginning for villages or counties as a whole. Most of the European countries are still getting the bulk of their current data for agricultural statistics in the form of eye estimates prepared by administrative officials for local areas under their jurisdiction. Later on, the collection of data involved utilization of the information available to various organizations dealing with certain aspects of agriculture, such as fertilizer dealers, wine producers' associations, cattle breeders associations, market authorities, price control offices, etc. Although not always accurate, this information was cheap to collect and did not require any particular effort. Surveys of farmers were included in the program of work only recently. This type of development has primarily taken place in countries where cheap mail or interview surveys were possible. When accurate data were needed for any purpose, techniques based on measurement such as yield surveys, estimates of changes in the number of farms in various size classes, quality checks of censuses, etc. were developed.

A recent study of the state of agricultural statistics in 18 European countries provides a good cross-section of European conditions, both east and west. All the data collection projects in each country were identified; the total number of projects in the 18 countries amounted to 357. Projects were afterwards classified according to the method of collecting data or the source of data, with the following result:

Method	Number of Projects
Sample surveys based on physical measurement	13
Sample surveys based on interviewing	77
Secondary sources	146
Mail surveys	54
Eye estimates and guesses	67
Total	357

The meaning of these figures is clear. In the most developed part of the world the cheap approaches, such as the utilization of secondary sources and eye estimates, represent the predominant source of data (many data coming from secondary sources are also eye estimates and guesses). One should also notice the large number of mail surveys which are also practically costless. Then follow the interview sample surveys which are relatively cheap. There are only 13 sample surveys based on physical measurements.

A review was made of methods being used in 120 countries for the collection of data on some of the most important characteristics in agricultural statistics. It was found that about 80 out of 120 countries use eye estimates in getting data on yield of wheat and maize. Similarly, 74 and 94 countries are using subjective methods in getting data on the number of cattle and milk production respectively. Thus, a large percentage of countries rely on subjective methods. These methods are cheap and simple. Recourse to such a tool seems to be essential given present knowledge and resources.

The facts presented above point to a rather flexible attitude towards statistical development and a need to utilize all the available sources of data and all the methods that are likely to be useful under given circumstances. These views are sometimes considered valid for the developed countries but not for the less developed countries, on the grounds that utilization of any method other than sample surveys assumes the availability of a developed infrastructure. In the immediate post-war period, and in those countries where the whole institutional set-up has to be built from the beginning, this argument has some validity. But much progress has been achieved all over the world, and all countries now have their basic subject matter agencies with staff who are reasonably well informed about national conditions in the field of their specialization. These specialists should be able to cooperate with statisticians and provide, wherever necessary, the basic office estimates. The same is true of the organization of field reporting. Some machinery of field staff is at present available to all governments and particularly to the ministries of agriculture. A systematic training of these people for statistical work could yield a field reporting system comparable to those in European countries. Utilization of secondary sources is equally possible, although this line of work is very much neglected. Agencies that have some statistical data certainly exist in any country, even in those at a low level of general development, for example veterinarian services, market authorities, price inspectors, agronomists, export-import agencies, marketing organizations, etc. Contacts with all these sources provide additional office guesses or parallel information that might be utilized in a number of ways.

These possibilities are being utilized on a very modest scale in many countries. But one has to recognize that there is no easy way to success. The work involved means the development of a systematic program of

cooperation with various agencies, a critical analysis of one's own achievements, and a continuous effort towards the improvement of what has already been achieved.

State of statistical work in the less developed countries

The most striking feature of statistical work in the developing countries is the ad hoc programming. Primarily this means a system of work in which a decision to start a data collection project is taken when the needs become urgent, or a possibility suddenly arises for the government to put aside some resources. In such a situation the time lapse between the decision to take a survey and the actual field operations is normally very short. Obviously, such an approach to work does not make possible the preparation of surveys in a systematic way and in accordance with quality standards. Similarly, the surveys resulting from such ad hoc programming do not represent a part of a well established system of statistics known to the government machinery and other users of statistics as well. Data from such surveys are not expected and not counted on as a basis for studies and decisions, and are not used as broadly as data from surveys from a program known well in advance.

Another common aspect of the ad hoc survey taking is hurried data processing. There is little or no care for a critical appraisal of the work done and for analytical studies of the procedures used. Time does not permit the development of a scientific evaluation of work, which is the only way to get objective information about the performance of various procedures, the frequency of errors of different types, the effect of these errors, etc. The lack of such an analysis makes it impossible to improve the work in the same type of surveys in the future.

In one country where practically no data were available, the government wanted to work out a five-year development plan of the national economy, so a decision was taken in 1967 to prepare a census of agriculture. In 1968 an adequate amount of money was put in the budget for a complete enumeration census with two visits to each holding, so that both the main season (July-August) and the secondary season (October-December) were covered. In early 1969 the government changed the decision and reduced the census operations to the main season only. By the middle of 1969 the preparations were not sufficiently advanced and a new decision followed to take a survey of the secondary season with some questions about the main season (to the extent that farmers were able to remember). At the end of 1969 only four regions were covered for the secondary season with a hope that the same regions would be covered for the main season in 1970. However, in 1970 only three regions were covered for the main season and no region for the secondary season. At the end it was realized that

the data could be tabulated only as partial surveys of some regions and of some seasons. Nothing else could be extracted from the results obtained.

The country later secured foreign assistance for the preparation of a development plan. Some of these resources were allocated to the preparation of a multi-subject survey that was supposed to provide information about basic characteristics for the country as a whole and some additional estimates for various regions within the country. An agreement was reached on the questionnaire, and work started in a small number of primary units and a relatively large number of secondary units (30 of these units at the beginning and 50 afterwards) in the selected primary units. After some work was already done it was found that other characteristics were more important than those included in the survey. As a result, a new questionnaire was prepared and used to replace the previous one. After some time another change of the questionnaire was made. Eventually some data were available. However, these data were collected in different years and with the help of different questionnaires, so that the intended provision of data as a basis for planning did not materialize.

Lack of links between surveys. Another problem of the present statistics in less developed countries is the preparation of surveys in isolation from both the past and the future survey work. Surveys are sometimes forgotten as soon as they are completed. The end of a survey is frequently also the end of the survey organization, and all the material used in the survey, such as various lists, sketches, maps, instructions, work sheets with data by small units, etc. is either destroyed or misplaced and forgotten. When a new opportunity arises to take a survey, the preparations are carried out as if this were the first survey of the kind and nothing could be used from the past to build upon. Similarly, when a survey is being designed or implemented no regard is taken of future work in which the present survey could be used very advantageously in a number of ways. The inefficiency of this type of neglect is clear.

In one country, for example, a considerable amount of money was spent to prepare maps, sketches, and aerial photographs of the national territory and designate on them the boundaries of the villages which served as the enumeration districts in the 1960 census of agriculture. This work was carried out systematically, and the government agreed to put in large resources hoping that it would be an investment which would pay dividends in future survey work. After the census was over the statistical office was transferred to another government building. In the course of the move only the most essential documents were taken while the furniture and everything else remained in the old building, including the mapping material. In the course of various organizations and reorganizations of that ministry the census mapping

material was always the source of anger on the part of those who had to carry it. They did not know what to do with it, and at some point it was destroyed.

After some years the preparations started for the 1970 census of agriculture. One of the first problems was the establishment of the frame of the primary sampling units. In the course of the discussions of the census committee it so happened that a member asked what had become of the material prepared for the last census. Nobody knew that such material had been prepared for the 1960 census, nor did anybody remember the history of that material. After an enquiry was made the story reported here came to light. This time, however, the government did not approve new resources for this work, and the 1970 census was in all respects below the quality level of the 1960 census. With a little more care for the use of public resources, the 1970 census could have easily been much cheaper and better than its 1960 predecessor.

Lack of analyses. It has already been pointed out that hurried preparations of surveys are always accompanied by a lack of studies and analyses. Studies take time. A properly prepared pretesting study needs sometimes more than a year, and such studies are neglected if surveys have to be prepared in a rush. As a result, decisions regarding various aspects of the survey design are based on guesses, some of which might be very wrong. Statistical literature is rich in examples showing to what waste of resources the lack of studies may lead.

In one country, a sample census of agriculture was taken around 1960, with settlements as primary sampling units and households as second-stage sampling units. The settlements were area segments larger than villages. In each settlement it was decided to take 40 households, as this was considered to be a reasonable load for the enumerators who would come to the settlement and stay there for days. In this way, 1,700 settlements were selected in the sample with 40 households in each of them. For any survey statistician the question will arise: why should there be 40 households in each primary unit? Two years after the survey was over, the data available from the survey were analyzed and the results in Table 1 obtained. One can see what is a very frequent result in sample surveys: the precision of estimates hardly increases by increasing the number of holdings beyond some limit. In other words, the inclusion in the sample of more than ten holdings per primary unit (and maybe even less) was a waste of money. But in the ad hoc preparation of surveys and in the rush to produce final tables these results did not impress anybody. They were forgotten. A new survey was taken some years afterwards with very similar questions. The design remained the same, except that the number of sample holdings in the selected settlements was increased from 40 to 50!

TABLE 1

The number of settlements in relation to the numbers of holdings per selected settlement which are needed for given percentages of standard error in the estimated area under rice.

(Total Settlement Numbers)

Percentages of standard error	Numbers of holdings				
	10	20	30	40	50
1	7.199	6.902	6.803	6.753	6.723
2	1.800	1.725	1.701	1.688	1.681
3	800	767	756	750	747
4	450	431	425	422	420
5	288	276	272	270	269
6	200	192	189	187	187
7	147	141	139	138	137
8	112	108	106	106	105
9	89	85	84	83	83
10	72	69	68	68	67

Source: Report of the 1960 World Census of Agriculture, Vol. III, Methodology-FAO, Rome, 1969.

Long-term program of work

Long-term programing of work is the way to improve the state of statistics in the less developed countries and reduce the impact of the difficulties described above. It is also a necessity from the management point of view. Current decisions and an adequate orientation of daily work are not possible unless the needs for data are identified, the corresponding targets formulated, the individual projects established, the work distributed over time, the necessary staffing arrangements secured, etc. In addition, some statistical projects require complex legislation as a basis of the action to be taken; before such legislation goes through all the necessary bodies, a lot of time might be needed. The same is true of the secondment of personnel and the participation of the administrative field machinery. It is true also of budgeting and the appropriation of adequate resources. Budgetary difficulties arising in big projects such as censuses of population, agriculture, industry, housing, etc. are very well known. In any case, the implementation of some projects takes years. To secure smooth development of such projects, it is important to have a detailed program of work for several years ahead so that the timing of various phases is adequately planned along with the time when various resources and facilities will need to be available.

A particularly strong reason for long-term programing of the work is methodological: various statistical projects have, or might have, many points of contact. A food consumption survey may be taken in a sub-sample of households selected for a labor force survey. The sample of the labor force survey could be selected from the lists of households established for a census of population. These lists, and the maps of enumeration districts, could also be used to establish lists of holdings for a census of agriculture. The preparation of the census of population can thus be, at the same time, the preparation of many other surveys. The quality of these preparations will have an impact on the whole system of surveys--if the census lists are inaccurate, it may easily happen that the same inaccuracy enters all other surveys using the same lists. The identification of common points among projects makes it possible to combine various activities and reduce the cost of implementation of the program as a whole.

The development of large-scale surveys such as area and yield surveys, labor force surveys and current population surveys has, in practice, required a long process of studies, observations, and experiments resulting from the implementation of a program spelled out over several years. The ability to visualize the implementation of a program in its time perspective is the condition for the achievement of efficient work. The statistical service has to have a view of its development established for a rather long period of time. On the basis of such views it was possible for some statistical offices to start with office guesses of agricultural production, move on to the training of field personnel for statistical reporting, switch to the use of the field agency for estimation purposes, use this agency for simple occasional sample surveys, and eventually transform these surveys into an elaborated system of large-scale data collection projects. A continuous research program was incorporated into this development process with a view to studying various aspects of data collection techniques. A training program was also devised to keep broadening the experiences of field staff. The development process was thus going from very simple approaches to the level of complex achievements. The basis of the process was a view of gradual improvements over a long period of time.

It is easy to see that long-term programing represents a basis for the elimination of the difficulties that follow from ad hoc programing, as shown above. But such programing should not mean a rigid approach to work. A list of projects cannot remain fixed for a long period of time in an absolute sense; the exigencies of life will always bring in some points that were not taken into account adequately, or impose new items in the program. The long-term programing is merely an effort to forsee future tasks as far ahead

as possible and organize the realization of these tasks as efficiently as possible.

The vision of development

In the preparation of a fresh long-term program of work or the revision of an existing program, there are three distinct and interdependent stages of work. The first is the establishment of the content. The second is the transformation of the needs for data into an operational system of work. The third stage, essential in the modern approach to the organization of statistical work, is the establishment of an integrated system of statistics, aimed at further improvement of the efficiency of the work and careful planning for the use of available resources. For integration purposes, all the possible links between various projects are identified and this information is utilized in order to secure the benefits that the implementation of each project can render to the rest of the program.

In this process of linking activities, one has of course to keep an eye on both past work and future activities. As to the past, an effort is needed to utilize everything that is available in terms of experience and information, such as maps, photographs, etc. With respect to the future, one is free to shape the work according to the efficiency requirements of an integrated system of statistics. Various activities can be put in a form that best suits the program as a whole. If one has to commence labor force surveys which represent a new item in the statistical system and has no previous experiences available on some problems that normally arise in this area of work, it will be appropriate to utilize the forthcoming census of population as a vehicle for an experimental program. The two projects are thus combined at the stage of planning in such a way that the analysis of the information collected in the census provides guidance for the decisions regarding the design of the subsequent labor force survey. Without such a combination, several experimental surveys would be needed before adequate knowledge is developed of the issues that arise in designing labor force surveys. Thus, the programing of the work in statistics is a creative act.

One could say that there is no statistical programing without a vision of statistical development. One has to have a clear idea of where one is going and what one wants to achieve over a longer period of time to be able to judge the present position on this road, and what steps are needed tomorrow in order to continue on the correct path. The need for a vision of statistical development is too frequently forgotten. Programing of statistical work cannot be successful if carried out by statisticians whose experience is restricted to some field of specialization, such as theory of surveys, data processing, general statistical theory, teaching some field of economy, etc.

People from this category are frequently unable to draw upon a sufficiently broad range of knowledge and experience. They either lack courage, or they have too much of it. The usual error is the colossal dimension of the work proposed.

A case history. The following case refers to the program of development of agricultural statistics in a country where little had been done before in this field, while the need for data had become quite urgent as a result of intensive involvement of the country in economic planning. As a systematic supply of data was not available, the statistician in charge of the project decided to start with an approach that was considered shameful by many people around him. He established a committee of subject matter experts, and during four sessions of this committee which were held at different points in the year he produced in his office the guesses for all the important characteristics. In this way the planners got the first basis to start their own work.

He took the decision to go into office guesses for he was aware of the need to be useful to the users as soon as possible. This also gave him the time necessary to take decisions on subsequent steps. His next concern was to improve the guesses. For the next year his program was a continuation of guessing with some improvements. As cereals were the most important commodities, the need to check the office guesses led him to establish cooperation with two agencies dealing with cereals that had their own statistical intelligence. An inquiry was first made to ascertain whether the two sources referred to the same coverage--i. e. the latter data might have referred to the marketed production only, to the private sector, the estimated consumption reduced for imports, etc. If the coverage is the same, a study can be made with the cooperating agencies of the quality of the information available; their data might also be office guesses, but they might be prepared by better subject-matter experts than in the former case. They may also represent an administrative adjustment of the information available from earlier years. In the event that it is found that the subject-matter agencies have data considered superior to the guesses of statistical offices, the cooperation of these agencies will be secured while preparing the subsequent office guesses.

The cooperation with the subject matter agencies was established and the agencies did what they were able to do. However, the statistician was not happy with this achievement. The planning activities continued to grow, and he thought that he should provide more and better data. At that point one might go in different directions. One of them could be the preparation of a census of agriculture, either on a sample basis or as a complete count. Another might be the organization of the machinery of field reporters. The choice will depend upon a broad view of the needs, resources, and possibilities over a longer period of time. As there was a need for a permanent system

of current statistics, he was convinced that the choice should be the reporting system. In this system estimates are prepared on the spot by the subject-matter officers for relatively small units. The information is costless, and available by small administrative units. It provides the ground for the forecasting of agricultural production. The reporting system might also be preferable at this stage because it represents a good basis for subsequent sample surveys. Available maps or aerial photographs may be used to delineate the boundaries of suitable segments as units for reporting. The total area of each segment is then computed. Next, the field agents will report the percentages of the total area under various crops and other characteristics for each segment. In this way a great deal of information will be available for each segment. Different types of stratification of segments can then follow. Thus, a convenient stratification might be available for sample surveys of areas and yield, livestock, or labor force, etc. This is how the ground will be established for an objective check (by sample survey) of the office guesses as well as of the reports coming from the field agents.

All these considerations led our statistician to the decision to start building a field reporting service. For years to come this service will have to remain exclusively involved in the preparation of eye estimates. However, it represents a nucleus of field staff needed for the future program of data collection. The implementation process was not very fast. The first year the reporters were recruited and trained to provide estimates for their respective communes according to a fixed time schedule. The first year of the operation of the system also provided many experiences that were very useful for the improvement of work. For example, some reporters did not report at all, while others reported crop areas which exceeded the total area of their respective communes. Others went too low. A map was, therefore, prepared for each member of the field staff of the commune under their respective responsibility, with the borders and main communications included as well as some important physical objects for orientation. The total area of the communes was measured on the map, and the approximate agricultural area was estimated from indications of the field staff. Afterwards, the staff were trained again on the utilization of these maps to reduce the possibility of repeating earlier errors.

The development of this system of reports took five years. During this time the office guesses were continued, so that two series of data were available; after five years the office guesses of current agricultural statistics were discontinued. Thus all these eight years represent an uninterrupted process of building agricultural statistics. Each year offers a contribution to knowledge, and this knowledge is the basis for the improved formulation of the subsequent program. One has to go through all the stages of this development process in order to see the problems, to get experience, and to teach the staff

to work on the basis of these experiences. Once this stage is reached, further refinements and extension into new activities can be envisaged and planned.

Personnel and Training

In the developed countries two different approaches are used in the education of the personnel needed for government statistical offices. The first approach is to get graduate students who have been through a university statistical program as their basic field of education, and then put them in some specialized office where they develop contacts with its subject matter and learn about the objectives of work, methods used, etc. The other approach goes in the opposite direction. It starts with basic education in some subject matter field, followed by work on statistics of the same subject matter, possibly combined with some study of the theory of statistics. In other words, if an agricultural statistician is needed, an agronomist will be recruited and sent to study the statistics. Both approaches are used in most countries. It appears that there is no clear advantage in using either one; excellent agricultural statisticians have grown up in both groups.

Considerable difficulties arise in the less developed countries, however. By definition these countries have not developed their statistical work far enough so that the office for agricultural statistics employs a number of professionals specialized in statistics, agronomy and a variety of related fields. These offices do not have an elaborate system of work which could be based on long experience nor studies carried out in the past to find adequate methods of work under prevailing circumstances. In this situation the young man who enters such an office as a professional has hardly anybody with whom he can consult. Often he is practically alone, and he has to take leadership in the development of the work under his responsibility by relying on whatever knowledge he has brought from school. This is why the matter of curriculum and school education becomes a fundamental issue in the less developed countries.

In most of these countries there is no local university for an adequate study of statistics, and it is usual to send prospective officers to some developed country. Upon completion of studies the young man goes back to his own country and gets a job as a statistician, say, chief of the office of agricultural statistics. His career is likely to be a long series of disappointments. Through the window of his office he will see around him crops he never heard of during his studies such as banana, cassava, cotton, cocoa, coconuts, etc. Afterward he will come in touch with agricultural practices that do not appear in the text books he used such

as shifting agriculture, mixed crops, continuous cropping, livestock of nomadic tribes, etc. He will soon realize that he knows nothing about the agricultural statistics needed under these conditions. The problems that he is facing are not dealt with in books, and he has nobody around him to ask for advice or experience. As a result, he will gradually go ahead on his own. He will develop some program of studies and observations, but as soon as the implementation of his ideas starts new problems will arise. He will learn that people are not educated enough to be able to cooperate with statistical offices; some are suspicious of his intentions, while others will reject any idea of contacts and supply of data. He will also find that little use can be made of local officials. Decisions in his ministry will be slow, the money is not coming in according to his plans, etc.

After he has gone through this long list of discouraging experiences he will very likely settle down to a kind of resignation. The initiative will be given up, and he will reduce his attention to routine matters. At some such stage the idea will arise of obtaining technical assistance. An expert will appear who had an excellent career in the agricultural statistics of some developed country. Soon after their arrival in a less developed country, most of the hard working and serious experts are likely to reflect an engineering philosophy of development. This approach to assistance for development may have a very positive effect in fields where the issues can be reduced to the kinds encountered in building airports or bridges, but in areas which are closely connected with the social infrastructure this philosophy has led to great difficulties. Too often the programing of the work is guided more by theoretical possibilities than by practical considerations. An illustration is the frequently encountered project of food consumption surveys which are expected to give data on the composition of food consumed by seasons, different geographic areas, segments of population, age, sex, occupation, income level, educational attainment, etc. Such a survey is an undertaking far above any practical possibility. Equally inadequate is the assumption that the governments of the less developed countries are in a position to formulate a nutritional policy that would reflect the results of such surveys. In the same category fall the projects of keeping up-to-date files of households, agricultural holdings, retail shops, industrial establishments, etc., which would serve as frameworks for current surveys.

Other failures in the same category follow from the assumption that the population will cooperate with the statistical services in the desired way. Sometimes farmers do not want to disclose the number of separate pieces of land they operate. Sometimes the farmers are not able to provide information about areas and production, as the units used in official statistics to express area and weight do not convey any meaning to them. In other cases they are superstitious and do not want to disclose names of children. They are also reluctant to cooperate because they are afraid of taxation or some other detri-

mental action coming from cities. In other cases a census of agriculture may fail because it was not understood that the fear that the data would be utilized for the purpose of agrarian reform will mobilize against the census all those who oppose agrarian reform for one reason or another. Similarly, a census of population may be postponed on the eve of the field work because of fear that it might affect the equilibrium between various political groups who are ruling the country.

Another area of difficulty is that a number of statistical problems cannot be solved adequately without experimental studies and field observations which, in some cases, extend over years. In the course of these studies resources are frequently utilized in a way that leaves much to be desired. The worst is probably the cases in which experts are looking for solutions in a wrong direction, for example by demanding too much in terms of resources. In other cases the experts are involved in a "discovery of America." They learn quite a lot and collect useful evidence regarding the problems they are facing, but their work had been basically already done by others. The right approach was, therefore, to learn whatever was achieved before in the field concerned prior to the preparing of their own program of studies and experiments.

Many lessons can be learned from failures. The most important concern the social dimensions of statistical work. It took a long time to understand that statistical development cannot go beyond the limits imposed by the social infrastructure. If the general education of the population is low and there is no tradition on the part of the population to cooperate with the statistical services, the statistical program is bound to reflect that background. There cannot be statistics of high quality without a high-quality statistical staff; these high-quality staff cannot exist without very broad and diversified needs for data which exercise a pressure on statistical work; the statistical needs in their turn express the level of development of a variety of other fields, etc., etc.

Research

In a discussion of the statistical problems of the less developed countries it may not seem appropriate to speak about research. These countries struggle with basic operational difficulties, and are thinking of ways of obtaining essential staff. It seems premature to think of research under such circumstances. As against this, I would like to state that research is at least as important in the less developed countries as it is in the developed ones, and indeed it is essential in the early stages of statistical development. The reasons for insistence on the need for research in the less developed countries are the following.

The present state of statistical work in the developed countries is based on a long tradition and experience. In the early pre-research stages, various impressions regarding the suitability of the techniques used emerged from past work; they made it possible to introduce many improvements. Eye estimates of crop areas and crop yields might be taken as an illustration. These estimates appeared very early in Europe as the method of collecting the statistics concerned. Being the subjective opinions of the officers involved in this work, these estimates have their peculiar characteristics from the accuracy point of view and they cannot claim much prestige. However, where the system of reporting had to be repeated each year the ground was established for comparisons in time. In addition, the work that was done for different reasons by a variety of people following the line of their own interests created a basis for comparisons between different people's results within the same year. Finally, here and there, a chance arose to compare these estimates with accurate figures: some farmers measure their production for one reason or another, and thus compare their earlier estimates of yield with the actual production.

If the less developed countries introduce such a system of crop statistics they will have little prior data in terms of these comparisons. They cannot go through the same process that the present developed countries have covered in their past because the quality requirements imposed on data are today much higher than before. The utilization of data on the part of government agencies is leading to very important and far reaching decisions, such as sale of surpluses, imports, exports, etc. An orientation towards quality is unavoidable, and research is the way to put a statistical office on this line. Research in the developed countries grew up as a tool to shed light on the performance of the methods of work, and it created the ground for more objective and more adequate decision taking. Neglect of research and indifference to modern standards in the less developed countries today would imply a lack of responsibility that the statistical service has assumed with respect to both the social role assigned to it and the resources entrusted to it for the purpose.

The most important fields in which research is needed in the government data collection agencies are the following: staff performance, methods of data collection, adequacy of tools, and various aspects of sample surveys.

As far as staff is concerned, the following questions arise in all surveys: how many people are available for a particular task in the country and in various administrative units, how best can the selection of the staff be carried out, what training do they need to qualify themselves for the work planned, how to check on the success of training, what is the performance of the staff on different tasks in the program and in different parts of the country classified by the age of the staff, sex, education, length of experience, etc. Need-

less to say, performance of the staff in the field will always remain partly an unknown. But the more work that is done along this line, the better and more complete will be the knowledge about the behavior of the staff in various situations. The planning of surveys will be greatly facilitated, and the chances of surprise and error will be reduced accordingly.

In one country a survey was taken with a very heavy program. More than 450 questions were included in the questionnaire. The preparations for the survey took a year and a half. Each of the field staff had a map of their primary sampling unit so that no danger of coverage errors was considered possible, and similar care was taken of the quality of listing. The staff were requested to put on the map each structure they visited, so that a check of the quality of listing would thus have an objective basis for evaluation. Despite all these costly preparations the survey turned out to be a complete failure. The field staff complained about the lack of cooperation on the part of the population, and pointed to difficulties in getting hold of people for interviewing. Eventually, only a fraction of the sample was surveyed. After the survey was officially declared a failure an inquiry was made in the field to ascertain the reasons for the failure. It was found, inter alia, that the main difficulty was that the staff were not prepared to go through a long survey program with all the households assigned. Their patience had not proved sufficient to finish the assignment. Had that study been made in the course of the preparations for the basic survey, many bitter lessons would have been avoided. Surprise results of this type are by no means the exclusive privilege of the less developed countries.

The field of data collection methods is no less important. Reference can be made to the well known dispute regarding the method of data collection in food consumption surveys, for example. In this field there are strong preferences for various methods: some people do not want to consider seriously any food consumption data unless they are collected by persons located in the households selected and who weigh the food before cooking. In another group are those who believe that the housewives cannot remember the type of food used and the quantities involved; they introduce bookkeeping into the selected households with instructions that each purchase should be recorded as soon as possible after shopping. Others consider that an interview survey is quite adequate if the information is requested for the food consumed during the last day, but find memory lapses for a reference period longer than a day. Finally, another group consider it adequate to take an interview survey with a week as a reference period on the assumption of regularity in the food supply for consumption. If one is guided by cost one might wish to have a single interview for a longer reference period. Accuracy considerations might be a temptation to use some form of physical measurements. Problems of staff, objectives of the survey, tradition, degree of cooperation on the part of

the population, general education of people, types of economy, etc. might lead to other choices. In situations where such a variety of choices exist, experiments to test the probable inaccuracies in different methods can help toward a more objective decision on whether a probable improvement in precision of results will be worth a particular increment in cost.

Another area of research is the tools used in statistical work, such as measuring instruments, maps, aerial photographs, lists of various units, questionnaires, etc. Each of these tools have some characteristics that are important for the outcome of their utilization, and which merit study and investigation.

The last area of research will be the design of sample surveys. It is a well known fact that the basic sampling techniques require information about the units available in the country, lists of units and the characteristics of the lists by all the levels in the hierarchy of units, the value of various characteristics at the level of different geographic units, the value of various characteristics such as aggregates, proportions, etc. by different area units, as well as the costs of travel and of obtaining data with different methods. Only after such a large body of knowledge is available at the table of the designer will he be able to establish the alternatives, and choose eventually the solution that can be considered optimum under given circumstances. Obviously, the information mentioned here requires the accumulation of results obtained in various research projects.

We have seen that research leads to savings in cost, to the possibility of doing more accurate work and making better choices from among the alternatives. But its meaning is much broader. Research is the way to organize and impose rationality on the accumulation of knowledge. This is the distinctive feature of research as opposed to the system of learning through trial and error. There is no question that some amount of knowledge and experience will develop without research and that common sense is always needed. However, the advantage of research is that it expands knowledge in the areas arranged according to their priorities, and in the ways considered most suitable under certain circumstances. Research is, therefore, the fastest way of building knowledge that is pertinent to needs.

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Statistical Policy in Less Developed Countries

Biplab Dasgupta and Dudley Seers, Editors

[The following selections, each with its separate author, are from a report on an international conference of statisticians, and deal with: employment statistics, national accounts data, problems of censuses and sample surveys, and the role and status of national statistical offices.]

Introduction
by Biplab Dasgupta

This report is based on the deliberations of a five-day conference on Statistical Policy in Less Developed Countries, held at the Institute of Development Studies, Brighton, England during May 12-16, 1975. It was attended by 62 participants from 26 countries, and preceded by a five-week study seminar. The main objective of this conference was to reconsider the priorities of statistical work, both by the statistical offices and by other bodies such as universities, to provide better measures of the economic and social health of a nation in view of the financial and skilled manpower constraints under which most of the statistical work is done in the less developed countries. Participants were perhaps equally divided among producers and consumers of statistics, and developing nations as against industrial nations and international bodies. It was expected that the conference would provide a forum for exchange of views between the 'producers' and the 'consumers' of data: the former would come to know more about the use made of the figures they produce, and the gaps in their coverage which require to be filled; and the latter would come to appreciate the difficulties under

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which the data are collected, and the danger of placing too much trust in figures printed in official publications. The participation of the members of international agencies was crucial to the success of the conference, both because of their importance as producers and analysts of statistics and also because one of the issues extensively covered by the conference was that of the possible conflict between international and national needs in data collection.

The discussion was lively, at times heated--as it should be. Many statistical conferences are stuffy and boring because the real issues of ideology and national interest that underlie statistical priorities are not brought out in the open. It was clearly a novel experience for many official statisticians to take part in the cut and thrust of professional debate where a contribution is valued more in terms of its content than of the status of the person who made it. One condition for a proper professional discussion of issues is that people should feel free from the obligation to speak in a representative capacity, even though many were sponsored by their respective organizations. We made it clear from the outset that the conference was entirely informal. Participants were also assured that there would be no resolutions passed or agreed documents issued for which they would carry any responsibility. This approach is reflected in this paper: it reflects views expressed, and indicates where there seemed to be a measure of consensus, but nobody is bound by it.

There was general agreement among the participants that: a) more and better data should be produced to measure poverty, unemployment and inequality; b) more 'social' variables should be covered; c) more administratively generated data should be used to minimize costs of data collection; d) as much effort (if not more) should be given to analyzing the data as to their collection; and e) governments should be urged to provide more resources for statistical work. But on most other issues there was no clear agreement among the participants.

One of the controversial questions, which was discussed at great length, was how to reconcile the needs for international comparability with the specific domestic needs of individual countries. The System of National Accounts (SNA) was chosen as a special target of attack by some members, who felt that the less developed countries needed detailed data according to regions, income categories, ethnic groups and other criteria. They argued as to the reliability of an aggregate such as the GNP, when the components were not available. [Note: the SNA, or System of National Accounts, is the United Nations' format for requesting comprehensive national economic data from its member countries, as formulated first in 1951 and more elaborately and definitively in 1968.]

Another major issue was the role of a statistician vis-á-vis his government. Concern was expressed about the way various governments attempt to influence the work of statistical offices in their favor, and the need for statisticians to be independent from such interferences. The conference also noted the existence and importance of various types of semi-legal or illegal transactions, which make the task of quantifying economic activities difficult, if not impossible. Examples given were: a) smuggling operations across frontiers; b) "transfer pricing" by multinational corporations; and c) transactions financed by "black money". Given the size and importance of these activities in many countries, national accounts which do not take account of these operations are unlikely to be of much use. On the other hand, it was recognized that there are practical difficulties in measuring these operations.

EMPLOYMENT AND UNEMPLOYMENT

by M. A. Bienefeld, Fellow of the Institute of Development Studies

Measures of the utilization and non-utilization of labor are rightly of central concern to analysts and policy makers at a time when the intractability of problems of poverty and of lack of access to productive assets looms large in the less developed countries. Unfortunately various aspects of this problem tend to be lumped together in the statistics collected currently, so that the resultant information is often difficult to interpret. There are two major aspects to this problem. On the one hand, there is the problem created by the uncertainty and the level of productivity of the economic activities in which people engage. On the other hand there is the consequence of a low level of productivity (or of a high level of productivity combined with unfavorable distribution mechanisms), which is poverty and the social problems that accompany it.

Traditionally, concern with these issues has combined the two aspects of the problem by collecting statistics on labor utilization and on income and consumption in relation to individuals. The inadequacy of this approach lay at the heart of the discussion, which focussed on the search for a different basis on which to collect these statistics. For this reason there was relatively little discussion of those definitional problems which are the focus of attention for most discussions of this kind--i. e. who is a member of the labor force; what is an economic activity; how hard must one be seeking a job in order to be classed as unemployed. The importance of these questions was accepted, but the main task was to find a possibility of establishing measures which would deal separately with the two aspects of the problem.

Why is this separation necessary? Basically because people do not produce, consume or allocate their labor as individuals. They produce in the context of a particular structure of enterprises and institutions and their activities must be assessed in relation to these. But they consume in the context of a particular social structure; and the pooling and redistribution of resources which that entails has led some observers to remark that all work in this area which is not based on the household (or the socialist commune) is meaningless. Finally, they make decisions about the allocation of labor-time, again within a social context, so that an individual's non-participation in the labor force, unemployment or under-employment takes on meaning only in relation to the size, the structure and pattern of economic involvement of the household (or other social units) within which the decision is made. For example, the unemployed head of a non-working family is not of the same significance as an unemployed adolescent living with two working parents. This was the background to a discussion which explored the problems and

possibilities of collecting less ambiguous statistics. Such statistics would look at labor utilization by looking at individuals in the context of their employing organization, and they would look at poverty, welfare and labor under-utilization by looking at individuals in the context of their family (clan, commune).

Employment statistics. The primary need here was for employment statistics which were integrated with production statistics. Furthermore, this general issue of labor utilization must be understood in relation to the process of capital accumulation and technical change at every level of production, so that statistics on employment will eventually illuminate the processes which generate the demand for labor time. Hence employment statistics must, in the first instance, be collected in relation to activities rather than in relation to individuals.

In collecting statistics on the demand for labor time and on labor utilization, it is necessary to differentiate activities on the basis of the manner in which, or the laws by which, they generate such demand. The most important distinction lies between capitalist enterprises generating demand for labor in order to earn a return for investors and operating under the laws of the market, as against other activities centered on a communal unit (usually a household) which is concerned with the utilization of its own labor resources. In practice this distinction largely coincides with the distinction between the enterprise (large and small) sector and the household and peasant sectors. A further distinction should also be made among types of activities: the production of saleable commodities, the provision of services related to distribution and finance, and the provision of personal services--since each of these conforms to rather different patterns of growth and presents different data collection problems. Accordingly, statistics should be collected on the basis of sets of productive activities producing similar goods or services. Where these sets include all levels of production and are treated as one unit for purposes of collection, the statistics should allow their stratification into large scale (foreign/domestic) enterprises, small scale enterprises, and household-based enterprises.

In general terms the kind of information that should be collected--with the level of detail subject to availability of information and resources--includes: levels and types of employment; age and growth pattern of business; output, value added and profit; capital employed; prices of standard inputs and outputs; characteristics of the labor force (sex, age, migrant status, seniority in job and in firm); types of markets served. Naturally some of these variables would not be of great interest for some types of activities, and other variables will be important at certain times, but by and large the information indicated covers the most important issues.

The collection of such statistics, covering a much broader range of activities than are presently covered by official statistics, should be done by groups within the statistical offices exclusively and continuously concerned with data collection on specific productive activities. In this way it is possible to learn enough about the technical and social characteristics of the activities to allow the introduction of many significant, but presently (officially) unknown, distinctions into the statistics such as contracting on a labor only basis, contracting to do a job, subcontracting from another contractor, building and financing structures on contract, building and self-financing structures for subsequent sale. Such knowledge would allow a more effective identification of those activities whose productivity levels are most inadequate, while also allowing a much better understanding of the ways in which large and small-scale production interact over time.

It would be necessary to begin with some initial census or household survey information to provide an approximation of the universe to be surveyed. In general, the greatest practical difficulties would arise in attempts to survey household enterprises. Here, reliance on an initial survey or census, updated by discussions with those engaged in or connected with the activity in question, would in time provide as comprehensive a picture as it is possible to construct. Beginning with the known producers, the teams could use these households as sources of information about others producing similar goods/services. Furthermore, often (though not always) it would be possible to trace such producers through the points at which they obtain raw materials, tools or other inputs or through the marketing channels which they use.

There was some feeling that the aims of this proposal could be achieved merely by doing some separate "informal sector" surveys to add to the statistics presently collected. This, however, would not allow the integration of information from different parts of the productive process, nor integrate production and employment statistics. There was nevertheless some question whether these suggested new activities should be carried out instead of, or in addition to, some of the present work of statistical bureaus. The answer to this must depend on its being shown that these current statistics add important information not otherwise obtainable. This does not appear to be the case in all countries.

Poverty and unutilized labor. In addition to understanding the processes by which the demands for labor-time are generated, it is necessary to study the way in which those processes affect people. As has been argued, problems of welfare, labor surplus and labor allocation need to be studied and measured in the context of the household (or relevant social unit). There are of course some

well-known problems of defining this unit; in this case the issue is further complicated by the fact that, strictly speaking, the present objective requires two definitions: on the one hand, the social unit responsible for decisions about labor allocation--i. e. the individual, the nuclear family, the extended family, the clan, the commune; on the other hand, the unit must be defined on the basis of expenditure decisions. Fortunately, the units responsible for labor allocation are unlikely to be greatly different from units defined on the basis of common expenditure decisions, so that in the great majority of cases the use of a common definition presents no special difficulties. There is some difficulty in cases where fractions of one household unit (as defined) live in different locations: ideally the entire household should still be treated as one unit, but the practical problems for data collection are virtually insurmountable. In most cases a normal definition based on the "common kitchen" (suitably amended to exclude visitors) will provide a reasonable proxy for the units to be defined.

It is clear that the social, and the economic, significance of unemployment and of underemployment can be understood more effectively in the context of the social unit defined in this way. Thus, unemployment becomes a complex measure which indicates the scale on which certain members from certain types of households are unemployed; and information about the economically active and inactive population is integrated generally with information on their household units. As for underemployment, one might measure it in the usual ways--hours, productivity, income--when the measurement was based on the household. Alternatively, one might argue that the measurement of underemployment is not a helpful exercise, on the grounds than any definition of a norm for productivity or labor time levels (below which "underemployment" is found) would be arbitrary and not operationally useful.

The household focus suggested here deals very effectively with the vexed problem of unpaid family labor, since income is seen as accruing to the family and labor is expended by the household unit. Indeed the problems associated with this issue stemmed precisely from the attempt to treat through 'individuals' what was in effect a family matter. In general terms, the household surveys suggested should collect information on: the present and past composition of the unit; the income (money and non-money) earning activities of the unit; some information on consumption (nutrition); the household's 'demand' for additional employment or work.

As for practical problems of collecting the information suggested, conference participants raised legitimate concern over the difficulty and expense of carrying out large-scale household

surveys employing very long questionnaires. It is well known that past attempts on various grandiose scales have often failed. It is proposed that the most effective way of dealing with this problem is by the use of various forms of stratified stage sampling, starting with a large sample employing a minimal questionnaire designed only to identify certain significant characteristics. This should then be followed by smaller, stratified sub-samples involving extensive interviews with a limited number of households.

Integrating production and household data. Having made a case for disaggregation, there remains the problem of integrating the activity and the household surveys. Where the household is both the unit of production and the unit of consumption and labor allocation there is, of course, no problem of integration. In other cases it might be necessary to draw a sub-sample from the activity survey in order to visit those selected at their homes. Alternatively the activity surveys could be structured so as to yield sufficient information about the respondents' domestic circumstances to allow them to be 'associated' with a certain type of household, located in a typology derived from the household survey work.

Peasant production makes up a large proportion of economic activity in many underdeveloped countries, and this is a prime case in which the unit of production and the unit of consumption is one and the same. However, there are severe problems common to any efforts to collect information, including the kinds indicated here, in a rural setting. At the same time there seems little doubt that the procedures outlined here would be better suited to meeting these difficulties than the usual methods of data collection employed in rural areas.

This brief summary represents an interpretation of the broad direction in which the search for better employment statistics was taken in the course of the conference. Clearly the proposals put forward here are not presented in a way in which they could be put into practice right away; there was not time to work them through to that level of detail, nor to generalize matters which depend so critically on the available resources and the complexity of the situation to be studied. Rather, what this does represent is an argument identifying the critical weaknesses of the statistics collected in this area at present, and suggesting the kinds of alternatives which must be developed.

NATIONAL ECONOMIC ACCOUNTING
by Dudley Seers, Fellow of the Institute
of Development Studies

This was an area of keen controversy. It centered on the question whether, as many official statisticians claimed, international and in some cases bilateral aid agencies were distorting statistical priorities by putting pressure on national statistical offices to spend a good deal of scarce professional manpower on what was needed to fill in returns or to provide information to back an aid request, rather than devising accounting systems that suited national needs. Under such pressures, estimates were produced (e.g. for food production or services) which were neither needed by local policy-makers or analysts nor of defensible quality professionally.

It became really clear to me for the first time that questions like: Does the SNA [defined earlier] suit developing countries? put matters the wrong way round. The real question is: What are the key areas for policy or analysis? This will vary from country to country; in some it may be slums and nutritional deficiencies in the towns; or other inadequate health and educational services in the countryside. The statistical office should give initial priority to providing information on such problem areas. As it organized comprehensive annual surveys in an increasing number of individual sectors, it might at some stage (which is unlikely to come in the present century for many countries) feel justified in contemplating their being put together into a published set of accounts for the economy as a whole. The timing of this last step should depend in part on when the planning office felt the need for it. Clearly many do not. In a background paper, Michael Ward pointed out that "many published national accounts data are not really used" by planning offices where the main task may be project appraisal and program evaluation.

The prime need for an effective macro-economic plan is anyway likely to be an account for the leading dynamic sector--such as the account the Central Bank of Venezuela has prepared for petroleum. Such an account is particularly necessary where much of the sector is foreign-owned. In fact, individual accounts of major foreign companies are needed both by the government and the public, at least in countries where there is awareness of the problems of controlling such companies. To publish them--even to collect the data--may not be easy in countries where statistical publication is limited by 'confidentiality' clauses in legislation.

In addition, commodity flow statistics, tracing key primary products through their processing and distribution, are likely to be of major importance. It is of course true, as is argued by United Nations officials defending the SNA, that this System makes specific

provision for commodity balance sheets. It is also claimed that whatever degree of detail one wishes can be obtained by disaggregation of the main tables. 'Disaggregation', however, is the wrong way of looking at the matter. It implies that one can somehow obtain global aggregates directly, and then break these down. There is in fact no way of obtaining the aggregates except by adding together figures for particular activities. If one cannot construct tables of commodity flows, or accounts for key sectors, one cannot properly estimate the items on the main tables at all: thus the only practical way of estimating construction is by grossing up the data on imported and domestically produced building materials.

The UN Statistical Office and other agencies have a great responsibility not to encourage (in manuals, technical assistance and questionnaires) statistical offices to publish global or aggregative tables prematurely. It is necessary to build up statistics with a structure tailormade to the requirements of the country concerned. This does not mean that the SNA is useless: it can generally be adapted to meet national needs. When a statistical office is in a position to take the responsibility of moving from detailed statistics to global aggregates, it will be useful to follow international practices on definitions, so far as this is compatible with national needs. These could well be kept in mind from the outset, so that adjustments do not have to be made when aggregation is attempted.

The MPS [i. e. the national accounting system used in the USSR and Eastern Europe] provides an alternative accounting framework. There was an interesting, if brief, debate on this. Its proponents argue that this is an easier system for countries which cannot provide very elaborate statistics, because it is confined to material production. Aggregate material output may be regarded as more meaningful if increases in services, especially government administrative services, are not really desirable. On the other hand, if the national income is no longer considered an important yardstick of progress, this argument loses some of its force. Besides, the SNA does have the advantage of enabling fiscal operations to be traced through the various sectors.

Neither system makes provision for accounts showing the activities of foreign companies (an omission which reflects their origins in countries where these are relatively unimportant). Such accounts can certainly be grafted onto the SNA, without difficulty. The crux of the criticism of the SNA is not, in fact, that it cannot accomodate such needs, but that its emphasis is wrong. Reflecting the practice of the industrial countries, it focuses attention heavily on the main tables, especially the gross domestic product itself, and international agencies reinforce this bias by requesting national statistical offices to provide data for aggregates long before their preparation is defensible, resulting in figures which are little better than random

numbers. Of course, planning offices (or finance ministries) may need global aggregates, but there is nothing to stop them, with the help of the statistical office, producing national accounts on a 'back of the envelope' basis (making their hypotheses about unrecorded activities). Then the statistical office would not carry the responsibility for the publication of figures which are the product, in part, of guessing so wild that it detracts from the professional status of official statisticians.

It was argued by Kari Levitt that an aggregate account of savings and investment is particularly liable to mislead the public, and even planners and policymakers, because it could encourage them to assume that the total savings could be freely allocated to various forms of investment. In practice, however, there is little flexibility, especially in countries where the capital market is not fully developed. Those who saved decided how the savings should be used: thus corporate savings were likely to be used for reinvestment in the same sector (if they were not sent overseas); private savings were often mainly available for luxury housing; and much of the inflow of capital (reflected in the net import surplus) was destined for specific purposes, whether it originated in multinational corporations or aid agencies.

Defenders of the SNA argued that before its 1968 version had been prepared, there had been extensive consultations with the representatives of developing countries. These countries had endorsed the SNA in regional conferences; and the UN Statistical Commission, which contains a majority of such countries, had adopted it. However, it is undeniable that the professional input into the SNA came largely from the industrial countries, where experience in national accounting is much more extensive, especially in the 1950s and 1960s when the SNA was taking shape. Many countries were still colonies then or only recently independent, and their own accounting systems had often been constructed in the colonial period. In such circumstances, and given the shortness of time to discuss very complex issues, consultation was inevitably rather a formality.

The main questions are: whether special provision needs to be made in the accounts for foreign companies, public corporations, the informal sector; which key sectors need to be shown separately (e.g. oil, copper, sugar or tourism); and whether there should be geographical divisions corresponding to political or socio-economic entities. If the accounts have actually been built up gradually from sectoral detail, corresponding to problem areas, these issues will hardly arise as the pertinent data are available. However, it would help the long-term planning of national statistical work to indicate what sort of considerations need to be taken into account in constructing a structure of national accounts for any particular country. Very little research seems to have gone into this question, but it was much

discussed in both the seminar and the conference on statistical policy. Obviously it has a bearing on the choice of statistical priorities.

The eventual accounting structure should depend on a series of factors which determine the demand for statistics, and their supply:

Geographical. The area and diversity of a country; the degree of urbanization.

Political. The long-term objectives of the government, and the interests of those outside the government in alternative development strategies; the degree and nature of government involvement in the economy; and the extent of devolution of powers to provincial government.

Administrative. The quality of administration, especially the number and quality of economists and of statisticians; the extent of data gathering.

Economic. The importance of foreign trade and the degree of concentration on a few export commodities; the proportion of economic activities covered by large units; the relative size of agriculture.

These determinants of what sort of structure would eventually be appropriate appear so numerous that a very large number of structures would have to be considered. Some of these characteristics are mutually associated--thus small countries are generally more dependent on foreign trade, especially one or two exports, and, where the main source of foreign exchange is dynamic (e. g. oil, tourism or manufacturing), they tend to be highly urbanized and to have large government sectors. The accounting structure devised for Trinidad may not be very different from what would be needed for Libya--or for Bermuda or Singapore--since they will in each case start with the need to document the income flows generated by the key sector, and how they are transmitted (via the government or otherwise) to other parts of the economy. In India, Indonesia and Brazil, on the other hand, the main concern may be rather with the consumption levels of the poor, especially in rural areas, so the highest statistical priority may be needed for documenting these and for showing how much of the proceeds of agricultural production in different regions go to landlords, moneylenders, marketing agencies, etc. This points to priorities for regional statistics, possibly to be woven later into national data (which may be thought to have limited meaning for countries so large and diverse).

It would be helpful if statistical agencies, such as the United Nations Statistical Office, focused attention on the typology of statistical needs, and the consequent pattern of priorities in data collection, rather than on presumed common needs. No attempt

seems to have been made to organize case studies on what sort of mutation of the SNA might be found appropriate for various types of country, nor consideration of the point when the statistics for each sector had been developed to a level where they could be defensibly linked together into aggregates.

Comment
by A. Aidenoff, Deputy Director of the
United Nations Statistical Office, New York

The conference was informed about the approach to, and process of formulation of international guidelines and standards by the Statistical Office and Commission of the United Nations. The significant differences between requirements and circumstances of developing and developed economies result in differing but coordinated guidelines and standards on a world-wide and, in many instances, on a regional basis. The formulation of U. N. guidelines and standards involves extensive consultations and discussions with the national statistical authorities of the developing, as well as developed, countries at each stage. The preparation of the first draft is based on detailed study of their statistical requirements, circumstances and practices. The views and recommendations of the developing and developed countries are gathered as successive drafts are prepared. This is carried through correspondence with national statistical offices, through regional meetings, and in certain instances through expert groups in which experts from developing countries participate. The Statistical Commission also considers successive drafts of the guidelines and standards: the large majority of the members of the Commission are from developing countries.

Thus, the participation of the developing countries in the formulation of guidelines and standards is extensive and influential, not nominal, and results in worldwide and regional recommendations which reflect their priorities and circumstances. Nor can it be said that a conflict exists between these recommendations and the national statistical requirements, circumstances and possibilities. The international recommendations and suggestions not only are adapted to groups of developing countries, but also are made flexible and general enough so that individual developing countries may further adapt them to their own situation. The guidelines and standards are designed to furnish a kit of concepts and tools from which countries may choose and adapt those appropriate to their own circumstances. It is recognized that the data reported to international agencies must come from the series gathered and compiled for national purposes.

Comment
by C. T. Saunders, University
of Sussex, England

I would like to put on paper some reflections about the "conflict" between the functions of national statistical offices and those of the international organizations, as I feel that this report oversimplifies and gives undue weight to the issue. That some conflict is felt to exist is clear from the views expressed by some of the participants in the conference. The sentiment is natural and probably unavoidable in present circumstances. It is not altogether different from the problems of an understaffed enterprise confronted with demands from a national statistical office for information which does not flow from the enterprise's own accounting system, and which seems to the management an unnecessary distraction from its proper business. The statistician normally replies that in an open society it is part of the business of an enterprise to give information about its activities for the general benefit of the society. How can this principle be sensibly applied on the international level? That is the real issue.

I cannot agree to the view that the international organizations are imposing their own priorities. The function of the international organization is to promote--it cannot enforce--and to communicate information about individual nations which meets the legitimate general needs of what we grandly call the "community of nations". Those concerned with the economic and social policies of developing countries need data about the rest of the world, including meaningful data about other developing countries. Among these general needs, a place can be given to the operational requirements of the international organizations themselves.

If the international organizations are calling for information which does not meet these legitimate needs, then we ought to have much more specific examples than their critics have so far produced of data requirements where the cost of collection, in terms of resources used, is in excess of the value of the information either to the supplying country or to the common interest. Of course, the root of the problem is the lack of resources (mainly of people) in many statistical offices--perhaps in most. All possible pressure should be put on governments to meet the needs more adequately. But statisticians should be the first to recognize that, even with scarce resources, it is right to allocate some part of them to giving information in meaningful form about their own country in return for getting the benefit of the experience of other countries.

CENSUSES AND SAMPLE SURVEYS IN LESS DEVELOPED COUNTRIES

by Nanjamma Chinnappa of the Center for South Asian Studies, University of Cambridge, England

The main sources of data used by governments and economic researchers are "official statistics", and statistics collected through surveys including both censuses and sample surveys. Official statistics are defined as data which are available because they are incidental to the process of administration, and are collected continuously by various government departments and institutions. They do not cover all the areas on which information is needed for guiding policies, and even in the areas for which they are available the data tend to be incomplete, inconsistent (because uniform concepts and definitions are not specified), biased (because they are affected by the primary purpose for which they were collected--e. g. revenue) and often out-of-date because of the low priority given to their compilation. These factors change slowly in developing countries, and often independent surveys are required to confirm or show the shortcomings in official statistics and cause governments to plan their improvement.

Most nations therefore depend largely on censuses and sample surveys that are designed specifically to meet their data needs. Censuses and sample surveys are periodic exercises in data collection, compilation and analysis, the basic difference between them being the coverage of the universe to be studied. Whereas a census implies collection of data from all the units in that universe, a sample survey is a study of a part of that universe selected specifically for the purposes of the survey. Censuses are the only means of providing data for every single unit in a universe, or by very small breakdowns. Sample surveys are often preferable to censuses from considerations of cost, feasibility, accuracy, and timeliness of results. In choosing between a census or a sample survey one needs to weigh these factors, and to ask the basic question whether information for every single unit or by detailed breakdown is absolutely necessary for policy decisions. Censuses and sample surveys are not necessarily alternative, however; they are often complementary, and draw on each other in many ways. A sample survey conducted in conjunction with a census helps in collecting additional data on items that need special investigation techniques or more probing than can be afforded in a large-scale census. Intercensal sample surveys help in making census data up-to-date. Postcensus sample surveys are used to estimate the accuracy of census results. A census often provides the best sampling frame for designing efficient sample surveys, and is used in improving estimation procedures and to calculate raising factors to be applied in estimation from such surveys.

Organizing a survey is most often an expensive, time-consuming and demanding exercise, whether it be a census or a sample survey. All the steps in its execution need to be foreseen, carefully planned and fully provided for. If a survey is only a part-time activity for researchers or government personnel with other commitments, this often results in an unfinished survey or unusable data, thus defeating its purpose. It is wise to provide adequate spare funds, time and research capacity in budgeting for a survey to meet the needs of flexible objectives and unforeseen problems that might be encountered. The organizer or researcher responsible must be associated with the survey from the very inception, and should be working full-time on it until the final results and reports are out. The statistician and computer programmer (if modern data processing is used--or even if not, to provide for future processing) should be consulted even at the stage of defining objectives, deciding the data coverage, drawing up the schedules and questionnaires and training the investigators and coders. Statisticians and programmers are sometimes consulted after the survey has been planned, or even after the information has been collected and coded, when it is too late to rectify matters that have gone wrong.

Since so much can be gained from the experience of other surveys it would be worthwhile if survey reports included a methodological section which covered, besides the details of the data collection, processing and estimation procedures used, a section on the problems met in organizing the survey and how they were tackled.

Objectives of the survey and data coverage. The new directions in development policy usually ask for more data rather than less, and often require a change in the universes studied and in the methods of data collection and presentation used in conventional surveys. But surveys are not ends in themselves (as they sometimes unfortunately become). The guiding principles in planning and executing a survey must therefore be utility and usability of the data collected: utility or usefulness of data will depend on the objectives of the survey, and usability will depend on the objectivity, reliability and timeliness of the data and its presentation. Data that do not meet both these criteria will only burden and delay the survey at all stages of its implementation, often polluting the reliability of data that do meet these criteria. The danger in presenting data subject to high response errors is that, in spite of warnings by the researcher in the report (often made only once in the preface or introduction), the respect and awe that numbers command can cause them to be used and misused without any reference to their reliability. Even well-established survey organizations with set patterns of data coverage, collection and reporting would benefit from constant questioning and improving upon the utility and usability of the data collected. There is much to be gained from keeping the program of a survey flexible so as to be able to add to or delete variables or observations, or change the data collection methods after preliminary studies of the data at the early stages of the survey.

In a census, the size of the universe, the difficulty of access to all the information units, the need for a large temporary field staff (who are expected to complete the enumeration as a one-off part-time job in addition to their normal duties for a nominal payment), the huge hierarchy of personnel necessary to supervise the census, and the sheer volume of the data to be processed and tabulated, impose severe constraints on the quality and timeliness of the data. It is difficult to train the enumerators thoroughly and uniformly, and to make effective checks on the accuracy of the data. To be usable, therefore, the data sought in a census are preferably restricted to items on which information can be collected by means of simple, direct, unambiguous questions which are easy to ask and understand, and which elicit ready, relevant and reasonably accurate answers--even when the information is collected from a secondary informant. These considerations limit the census data that can be usefully collected to a short list of basic items such as age, sex and housing conditions in a population census. The feasibility of collecting usable information on other socio-economic variables such as migration, employment and activity status which one would like included in a census will depend on whether simple and feasible definitions can be evolved for these items, and on situations in each country. Even if considerations of reliability indicate that such socio-economic data ought not to be included in censuses, the fact that a vast quantity of time, money and effort is invested in a census and that resources are not available for supplementary sample surveys might dictate the need to expand the scope of the census to include at least some of these socio-economic items. In developed countries like the UK with a long history of data collection, the census has proved to be a useful, though a blunt tool for providing employment statistics, but even so there are coverage errors and biases that could distort conclusions. Great care must therefore be taken to ensure that a census questionnaire is not overburdened, and that data are collected with as much probing as possible.

A pilot census in difficult areas of the country with independent detailed checks would help in deciding what to include. Data that are 'difficult', exploratory, relate to rare units or to topics that require to be studied in great depth, need to be handled by case-studies confined to very few units. Such studies do not permit wide generalization, but are useful in studying new topics and interrelationships between factors.

Concepts and definitions need to be explained clearly to the investigators so that the data collected are consistent with the objectives of the survey. Definitions should be tested in pilot surveys before being finalized. In complicated cases like 'employment' and 'activity' status, where economists who use the data cannot agree on the definitions, the survey should allow classification of the units by the various component categories of possible definitions so that these categories can be regrouped as desired by the user. The UN recom-

mendation on concepts and definitions should be seen as guidelines that will, if followed, help in facilitating international comparisons and in evolving more useful data. Often these will have to be adapted to the socio-economic situations of each country to ensure that the data are relevant and accurate. Whether data can be collected by component categories of both the national and international definitions merits investigation.

Questionnaire and schedule design. The principles of questionnaire or schedule construction are well known and have been discussed in many books. Planners need to be aware of the temptation to overload the questionnaire or schedule. The content, format and instructions to the schedules need to be kept flexible to allow changes if required on the basis of the actual field experience. Continuous supervision, and frequent discussion of problems in data collection by field staff with the supervisory staff and researchers will help in this.

Often schedules are prepared first in English or a major language of the area and then translated into local languages or dialects. Getting these translated schedules translated back by an independent person to the original language in which they were drafted will help the researcher to see whether the meaning and content of the questions have changed in translation. This also applies to written instructions: instructions in writing to investigators are a must, both as a mind-clearing exercise for the researcher and to ensure uniformity in concepts and definitions followed.

If pre-coded questionnaires are used, the trade-off appears to be between the risk of inaccuracy of data and the facility for quick data processing. Responses to pre-coded questions are difficult to check at a later date, and they need experienced and reliable interviewers, careful supervision during the survey, and exhaustive listing of all relevant and possible answers on the schedule. Recording the exact answer given by the informant on the schedule and coding it later using a trained team of coders generally leads to more accurate results than coding answers when they are obtained, although it is a time-consuming process. Sufficient space should be allowed on schedules for comments by the investigators and supervisors on relevant items not covered in the schedule, and for explanation of unusual entries, so as to help in checking and improving the quality of data. It is advisable to use a household schedule where the names of all members of the household are recorded first before other questions are asked.

Schedules should be printed on good lasting paper. Facilities should be provided for storing the schedules by the investigators in the field and later at the processing office so that they are not misplaced, and to ensure confidentiality of the data. Facsimile copies of the questionnaires or schedules used should be appended to all survey reports so as to enable the user of the data to be aware of the manner in which the data was collected and recorded.

Pilot surveys. These must be undertaken at all costs to train and test investigators, to test schedules, concepts and definitions, and to assess the work load and variation among sample units. Tabulation programs and computer processing can also be tested by carrying the pilot survey data through all the stages of processing and tabulation.

Investigating staff and data collection techniques. One of the basic problems in surveys is the difficulty in motivating investigators and getting the best out of them. Their background, basic qualifications, experience and nature affect the quality of investigation. An important factor often ignored is the job satisfaction of the investigators: poor pay, limited promotion prospects, unsettled family life, difficult working conditions, and monotony of the job (asking the same questions over and over again) contribute to low job satisfaction which can result in data of poor quality. Efforts should be made to improve this situation. While recruiting investigators, one should look for persons who are amiable, unassuming, patient, sympathetic, observant, who are able to converse freely with all kinds of people, are amenable to being instructed, can follow instructions intelligently and have a good memory. Experience indicates that investigators with backgrounds similar to those they are investigating collect better data, although if the investigator belongs to the very group being studied the quality of data may suffer because of informants' reluctance to divulge information to a person who knows them. Permanent staff have the advantage of accumulated experience and perhaps proved trustworthiness, while staff with no prior experience may be easier to instruct because they have no preconceived ideas, and do not have to unlearn different concepts and methods used in other surveys. Temporary staff can be readily replaced if they prove unsatisfactory, but this may not be so easy with permanent staff. Over-qualified investigators are likely to be a liability because they would be looking for better jobs. In any case, a sufficient number of reserve staff should be recruited and trained to be able to replace investigators whose work is unsatisfactory, who have to stop work temporarily for some reason, or who leave the job. It is useful if these reserve staff are employed as coders until the need arises to shift them to fieldwork, so that they are quite familiar with the survey work.

The duration of stay of the investigator in the area of survey (e.g. a village) will depend on the objectives of the survey, the nature of data to be collected and the time and cost constraints. Data that do not ordinarily need more than a single interview (e.g. basic demographic data, housing, implements) do not require investigators to stay in the survey area. In some countries, residence in the survey area may not be feasible, in which case arrangements should be made for investigators to stay at a convenient center within easy reach of the survey area. In most socio-economic enquiries that require detailed probing, a good rule is to allow the investigator sufficient time in the survey area to familiarize himself with the people and the

area so that he can check the reliability of the data, both from general impressions gathered during his stay and by visual verification of data that can be verified. A longer period of stay will also permit data to be obtained from informants at a time and pace that suits them, and will lead to data of better quality. Adequate transport facilities and liberal travelling allowances encourage investigators to make repeated visits if required to check on data and to contact informants who are not easily available.

Acquaintance of the investigating and supervisory staff with the general purpose and significance of the survey will help in motivating them. Periodic meetings between investigators, supervisors, coders and researchers should be organized during the survey to discuss problems encountered during data collection and any modifications in the survey objectives or instructions. Publicizing the objectives of the census or sample survey may help in motivating informants to provide reliable answers and in convincing them that the data will be kept confidential. Persistent cases of non-response should be tackled with the assistance of senior survey officials and of local officials who might be able to persuade the non-respondent to cooperate. An unwilling informant may be substituted by a similar informant selected by the researcher from the sampling frame using the same sample design, but the field investigator should never be allowed to substitute an informant himself.

It is worthwhile encouraging both investigators and supervisors to write notes on some interesting topics related to the survey, or make sketches of the sampled units such as informants or villages. This helps in motivating the field staff, and makes them more observant, relieves the boredom of collecting routine data, and gives them a deeper insight into the subject being studied. These notes should be circulated among the field staff and could be used and acknowledged in the final report.

The sample design used depends on the objectives of the survey, the nature of the universe to be studied, the sampling frame available, the data collection methods used and the resources that can be afforded. A random sample helps in avoiding human biases in selection and is essential if generalization from the results of the survey is intended to allow valid use of statistical techniques of analysis. In general, however, because of the magnitude of non-sampling errors in most socio-economic surveys in less developed countries, it would be advisable not to use sophisticated sample designs but to concentrate effort on minimizing non-sampling errors. Self-weighting designs are useful in speeding tabulations and in allowing researchers to analyze the data without worrying about raising factors. Although theoretical considerations could be used to indicate the sample size needed to obtain estimates with the desired sampling error, the overall sample size is often fixed by the resources available.

It is advisable to look for existing sampling frames, especially when time and budget limitations are severe, even if it requires adjustments in the objectives. The frames used should be up-dated continuously, and basic items of information collected from them, so as to facilitate improvements in the sample design and to keep the frames ready for future use. One need not be unduly worried about the completeness of the frame so long as its coverage is nearly complete and unbiased. Data available in sampling frames provide very useful background information, besides often being necessary to calculate weighting factors.

Checking and assessment of the quality of data. The need for adequate supervision and checking of the survey operation at all stages and among all levels of the survey staff can scarcely be over-emphasized. A sample of completed schedules of each investigator needs to be checked in the field by the supervisor during his visits, and every schedule should be checked for internal consistency at the processing office either by hand or by computer. If required, the investigator should check back on doubtful entries (this is easier if he resides in the survey area). Investigators should be encouraged to be skeptical of data given and not to be ashamed of correcting them later if they discover that they were erroneous. Circulation of scrutiny notes and their discussion at meetings of investigators help in this. Separate analysis of the survey data collected by each enumerator will help in discovering investigator biases. Planning and tabulating the data by replicated (or independent) sub-samples provides an easy estimate of both sampling and non-sampling errors.

All survey reports should present estimates of the magnitude of sampling errors for at least some important characteristics, and a discussion (if not estimates) of non-sampling errors met with in the survey. The magnitude of the sampling errors of estimators is often an eye-opener, and offers insight into the precision and reliability of the estimates. Census reports should present the findings of post-enumeration checks.

Data processing and analysis. It is preferable (when pre-coded schedules are not used) to code the items on the schedule itself and then transfer codes to coding sheets. Checking of the coding should start as soon as the coding operation starts, so as to pull up bad coders early and to sort out problems in coding. Starting with a 100% check, checks on coding sheets can be gradually reduced depending on the number of errors encountered in the work of each coder. A fixed format used in coding, besides being easier to follow, is easy to check and hence less liable to errors. This format is also useful for quick hand tabulations and for test checks of computer outputs. Punching should preferably be subject to a 100% check. Computer edits are also helpful at this stage; computer programs should be run on a sample of the cards and tested by hand tabulation. Computer packages, such as the SPSS, CENTS and FIND developed to

handle survey data, are very useful and are generally capable of handling most of the tabulation and analysis requirements of survey data.

Report writing. Many surveys end at the tabulation stage, but there is often a need for a descriptive report to help users in understanding the tables. Report-writing is frequently a difficult and time-consuming task, and being usually one person's responsibility, is kept pending until other activities have been completed. The task is made easier if the researcher writes notes during the survey, based on his field visits, on data available in the sampling frame and on preliminary tabulations of the earlier phases of the survey. He could use these notes and those written by the field staff (as suggested earlier) in writing the final report. Return visits to the field while writing the report would be desirable, if feasible. The draft final report should be circulated among the investigating and supervisory staff for comments.

NATIONAL STATISTICAL OFFICES

by Biplab Dasgupta, Fellow of the
Institute of Development Studies

Questions on the organization of statistical offices in less developed countries attracted a great deal of attention in the conference. (About half the participants were attached to the statistical or planning offices of various countries.) A wide range of issues were considered, from very specific subjects such as the use of administrative data, the location of statistical offices and the status of the Director of Statistics in the government hierarchy, to broader, more controversial issues such as the question of international obligations and relationships with the government in power.

The discussion began with the question of where the central statistical office (CSO) should be located. There was agreement that the ministry concerned should be a powerful one, with influence over different branches of the economy and having a wide perspective. The current practice in all but a few countries of putting statistical offices under the control of ministries such as finance, planning or development, would satisfy this criterion; but in some cases offices were tagged onto the Ministry of Justice or the Ministry of Agriculture, or some such ministry. Some participants suggested following the practice of the UK government in making the statistical office part of the office of the Prime Minister. It was argued that the powerful backing of the Prime Minister would be of great value in the CSO's confrontation with departmental ministers.

Related to the question of location is the issue of centralization v. decentralization. There was concensus that the extent of decentralization was a function of the size and statistical resources of a country. Countries with very few statisticians and data processing resources would probably prefer a centralized data collection, sorting and processing system. On the other hand, for countries with a bigger and more diversified economy and/or a good supply of qualified statisticians, there would be some justification in having separate statistical offices in different government departments. The participants also felt a need for regional statistical offices to prepare regional accounts, and to help policy-makers in the formulation of regional policies, particularly in large countries. But there are severe resource constraints on the extent to which such geographical decentralization could be implemented. For the majority of less-developed countries--small, and poor in statistical and financial resources as they are--there are limits to the possibility of decentralization. In countries which had adopted a decentralized system, it was found that the flow of data from departmental or regional offices to the CSO was slow. There is also the problem of maintaining the quality of data when they are produced by one department but mainly used by other departments. One way of overcoming these

problems of decentralization is to set up a body consisting of representatives from various government departments, as well as non-governmental users of statistics, to coordinate statistical policy. But here, more often than not, the tendency is for the departments to send to such bodies officers too junior to contribute or commit their departments.

Concerning the status and role of the Director of Statistics, it was agreed that his position in the administrative hierarchy should be as high as (or even higher than) those of the heads of various ministries; otherwise, how could he be effective in securing the latter's cooperation? In principle the Director of the CSO should be responsible for the appointment and promotion of statisticians in various departments; and should have access to, and control over, the quality of output of the various departments. Many participants commented favorably on the UK/India model, where the director of the CSO is also the head of the statistical service and hence is responsible for the careers of the statisticians in various individual departments. In addition, he enjoys the respect due to the head of the profession, which helps him to influence and coordinate the statistical activities of individual departments.

Discussion on the role and status of the Director inevitably led to the highly controversial subject of the relationship of the statistical office with the politicians, particularly with the ministers. The participants gave many examples of the way governments attempt to influence the work of the statisticians to their advantage. The following are a selection of those examples: (a) Asking the statistical office to manipulate or fabricate data. In the past, census operations of several countries have been suspected of being manipulated to exaggerate the proportional share of particular ethnic/racial/religious groups or regions. A more regular practice is to produce a rosy picture of the future, with long-term statistical forecasting based on dubious assumptions and data, to induce the people to support the government. (b) Asking the statistical office to suppress inconvenient data. This is a regular practice in many countries. The politicians in power justify this on the grounds of public policy. (c) In several countries, while the government would not favor outright suppression of data, attempts are made to lessen the impact of unfavorable data by inducing the statistical office to: i) change the format of statistical tables to hide some individual items under aggregate figures; (ii) hold back publication for some time until after an election or an improvement in the economic position; or (iii) add explanatory notes to tables to convey a false interpretation of the figures. Political bias also enters into statistical work indirectly, for example: (a) through the appointment of the head of the statistical office; (b) by encouraging research in certain directions and by withdrawing support for research on potentially unfavorable topics such as poverty or income distribution; and (c) by using data on individuals and firms for the purposes of political blackmailing.

There was agreement among the participants that the statistical office should be as automonous and free from political interference as possible. Some suggested that it should ideally be like the judiciary, or the auditor general's department; but others felt this was not practicable. A major task of the statistician is to provide the government with data; to be useful the statistician must be in direct and continuous contact with the policy-makers. What is needed is a balance between the need to operate as a government department, and the awareness that a statistician has a responsibility to the population as a whole (which includes those opposed to the regime), as well as to his own profession, whose high standards he is expected to maintain. His obligation to his people and to his profession should make him resist attempts by the government of the day to suppress, modify, fabricate or otherwise use the data to gain political advantages over its rivals.

Various aspects of the question of confidentiality were scrutinized by the conference members. It was agreed that there was a need to preserve confidentiality when the data were secured on the clear understanding that they would be treated with the strictest confidence. To betray this trust would be wrong, both in terms of professional ethics, and also because it would raise doubts as to the integrity of the statistical office, and hence discourage the respondents from furnishing reliable data. Data collected by statistical offices should not infringe the privacy of the individual respondent, nor expose him to blackmail or competition. On the other side, it was argued that these rules of confidentiality are often used by the rich to evade tax regulations. "Black money" accumulated by evading tax and other regulations is widely used in many countries for financing a large proportion of economic transactions. It was argued that a distinction should be drawn between information furnished by respondents to the statistical office on the promise of confidentiality, and information given to different government departments by the respondent on income, property, imports etc., where he is required by law to give truthful answers.

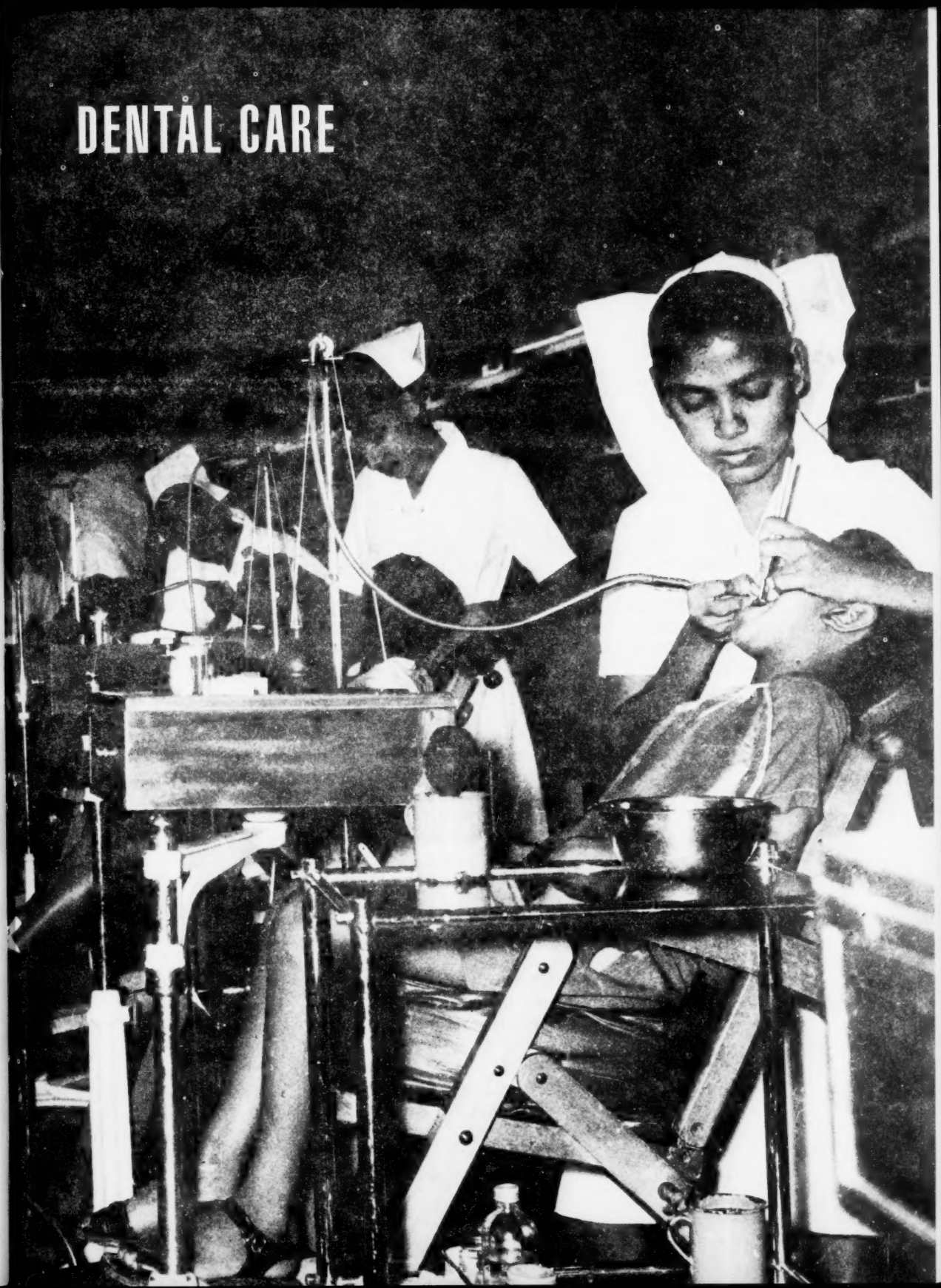
Some statisticians complained of the indifferent attitude of their governments towards statistical work. It does not always receive the priorities, financial backing or accolade it deserves; and in terms of salary, promotion prospects, and rank, statisticians compare unfavorably with generalist administrators. This inhibits the growth of statistical services and increases the rate of turnover of statisticians, who leave to join international agencies, private firms, or even universities. Most statistical offices suffer from a serious shortage of qualified and experienced staff, and are forced to rely heavily on expatriate statisticians working on technical assistance programs. Such technical assistance, while beneficial up to a point, does not offer a long-term solution to the problem of staff shortages. It was felt that technical assistance should be used to build up local

expertise: a good expert should work himself out of a job in the time allocated for the duty, and leave behind him an able local successor. Unfortunately, many of the experts are not good enough for their jobs.

On the question of priorities in statistical work, the participants agreed to the need for more and better data on poverty, unemployment and distribution of resources, and for a detailed disaggregation of national accounts subject to various financial and manpower constraints under which these statistical offices operate. There was consensus that statisticians should be more aware of the political and social environment from which the data are collected. Professional statisticians should develop interests in social sciences; and economists, sociologists and political scientists with statistical knowledge should be recruited to help in statistical offices. Such a measure would also help to bring the statisticians' work closer to the consumers of statistics. It was clear from the discussion that at present too little attention is given to processing and analyzing data; government departments are more interested in financing surveys and data tabulation than in establishing associations and cause-effect relationships between variables to reach meaningful conclusions for policy purposes. Governments are more interested in publicizing the undertaking of statistical studies to demonstrate their concern, than in using their results. A great deal of data, collected at enormous cost, is thus wasted; it was felt that the governments should enable universities and research institutions to use more government data, with the usual safeguards for confidentiality.

[Extracted from Statistical Policy in Less Developed Countries, Biplab Dasgupta and Dudley Seers, Editors. IDS Communication 114, published by the Institute of Development Studies, University of Sussex, Brighton, England, 1975.]

DENTAL CARE



GIRLS ARE TRAINED AS DENTAL NURSES
AND DENTAL TECHNICIANS IN SRI LANKA.
(Photo: International Labour Organization)

Dental Care in the State of Mexico

Gustavo Baz Dias Lombardo

[A Mexican program bringing dental care to poor people who have never had it has been working in one State. It includes: stationary dental care units for cities; smaller units which can be moved from time to time for rural centers; and portable units carried by jeep to remote areas.]

Until now, dentistry in Mexico has barely served to provide curative and restorative care to economically able social classes, with marginal attention to other sectors. There are only 14,000 dentists in the entire country to care for a population of 63 million--a ratio of 1 to 4,500--and virtually no auxiliary dental personnel. In the State of Mexico, which surrounds the Federal District (Mexico City), the ratio of dentists to population is only 1 to 15,400. Most of the population lack dental care, and even what is available is not of the highest quality. The dental schools tend to perpetuate problems by training professionals in methods of work appropriate for those members of the urban population who can pay. These dentists master a certain amount of restorative technology but have little capacity or desire to meet the needs of the great majority of the population; all too often they rely on the expensive techniques and equipment found in more highly developed societies. Dental clinics for poor people in the cities and rural areas are scarce, often of inadequate quality, and employ few dentists for the routine care of oral disease.

In a developing country, it is slow and difficult work to establish a dental delivery system, even for those

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of a high economic stratum. In Mexico, and in developing countries generally, equipment maintenance is extremely costly, due to distances from population centers, high importing costs, unavailability of spare parts, and a shortage of skilled technicians. Another deterrent to progress in developing countries is the delay in communication of recent advances in research, and the fact that most professionals have no funds to attend informative events--which usually take place outside their country.

The Pilot Program in Nezahualcoyotl City

In 1973 in Nezahualcoyotl City, one of the most densely populated marginal settlements in the State of Mexico, the State Health Council set up a new kind of health care delivery system. A member of the Health Services, appointed by the local municipal council, was given the responsibility for developing health programs in conjunction with the community, with the aim of attaining higher productivity and greater coverage. For the past three years, one Stomatological Care Module (i. e. a unit for care of the mouth, described below) has been an integral part of the city's health system, which also includes a general hospital, seven health care centers, three child care centers, and one sanitary control center. Financed by both Federal and State governments, and managed by the State Public Health Coordinated Services Bureau, the system delivers medical and dental care, carries out preventive work, has a community health education project, conducts sociological and epidemiological investigations, and provides a growing source of employment and health training for community residents. [Stomatology=science of the mouth and its diseases.]

A new stomatologic practice system in the city is being developed to serve as a model for dental care for the State of Mexico, and eventually for the entire nation. Making use of what we learned in Nezahualcoyotl City, we are proposing a system of regional centers to serve large urban communities, as well as handle referrals from their outlying rural areas which will have other arrangements. This system will have four basic services--(1) stationary Stomatological Care Modules in urban centers; (2) similar but lighter and more mobile geodesic-dome units in well-populated rural areas; (3) home-to-home care in sparsely settled rural areas; and (4) specialist services provided on referral from the other three services. The program budget for the five-year period 1976-1980 is approximately $5,425,000, growing toward an annual expenditure of $1,340,000 and a coverage of 200,000 people by 1980.

Stationary Urban Stomatological Care Modules. The Stomatological Care Module built in Nezahualcoyotl City consists of two prefabricated fiberglass sections. One section serves as an administration-waiting room area. The other section is the clinical area with nine

locally manufactured dental chairs grouped around a central service island. At each chair, using four-handed techniques, a clinical dental technician and a clinical assistant deliver basic dental care to children. The mouth is treated by quadrants under local anesthesia. No more than five appointments complete full mouth treatment. From the central island, an assistant prepares work trays and hand the operating teams the supplies they require. X-ray equipment is also available. (See photos on p. 80.)

The entire operation of this stationary unit is supervised by one dentist, who is also responsible for diagnosis and treatment plans and acts in situations for which the auxiliary and technical staff are not trained. Twenty-three persons staff the stationary module:

Dentist	1
Clinical Technicians	9
Clinical Assistants	11
Administrative Officer	1
Transportation Officer	1

Using this mix of personnel, a more productive job is done, of better quality and training value, and at a lower unit cost than in conventional clinics. The waiting room unit of the stationary dental care module serves as a classroom. Here, children either have classes with their regular teachers or receive education in nutrition and oral hygiene from the staff while waiting their turn. Buses are used to bring children from school as their treatment is programmed.

ses.]

We have found that, with community education, there is a growing demand for dental services, even when each child is required to pay something (10 pesos, or about 40 cents) per treatment for basic dental care. The average cost of basic dental care is 153 pesos (a little under $7.00) per child per year, and it is expected that 7,000 children will be treated annually. The cost per center is as follows:

Operating (annual)	$78,762
Capital Investment	$56,785

Concentrated Rural Area Centers. For well-populated rural areas, we have designed clinics of a light-weight structure, known as Tetra Hidros, that are basically similar to those used in urban centers except that there are only six chairs instead of nine. These units are prefabricated geodesic domes with metal ribs and plastic reinforced panels mounted on a cement base. These domes can be readily moved from one community to another, transported by trucks and reassembled as needed. They are self-contained units with their own power generators, water, and air compressors, and can be assembled or taken down in two or three hours by people

with no special training. It is particularly important that this be done by people from the community, both to provide needed employment and to interest them in the oral health system. In appearance the Tetra Hidro clinic is light and attractive and not at all intimidating to the children who come for treatment.

The program remains in a community from 6 to 12 months, depending on the size of the community. Children are treated at the modules, which also act as home base for dentally equipped jeeps traveling in the countryside. The auxiliary personnel are trained on-site, and when the program is moved to another place, these auxiliaries stay in their own community promoting oral health and maintaining education in dental hygiene and the basics of dental health.

The basic staff of 16 for the concentrated rural clinic consists of:

Dentists	1
Clinical Technicians	6
Assistants	8
Administrative Officer	1
Transportation Officer	1

We expect to cover 6,300 children per clinic per year under this program at a cost of:

Operating (annual)	$58,416
Capital Investment	$43,480

Home-to-Home Care in Remote Areas. In more sparsely settled areas, care is delivered on a home-to-home basis, covering the entire family in one visit. Trucks and jeeps set out from a "home-base" in the Tetra Hidro facilities to deliver dental care to the most remote places. The trucks can transport an average of ten units (each with one chair); where access is more difficult, jeeps carry only one or two units. All systems employ simplified self-contained equipment mounted in special cases for easy transport.

Each rural unit is operated by one clinical technician and one assistant. Personnel use the minimum necessary instruments and simplified techniques to provide basic care. They spend much time gaining the confidence of the general population as well as community leaders in order to leave behind better oral health procedures after they move on. Expected coverage is 1,200 persons per jeep per year. The cost (per jeep) is as follows:

Operating (annual)	$6,800
Capital Investment	$2,800

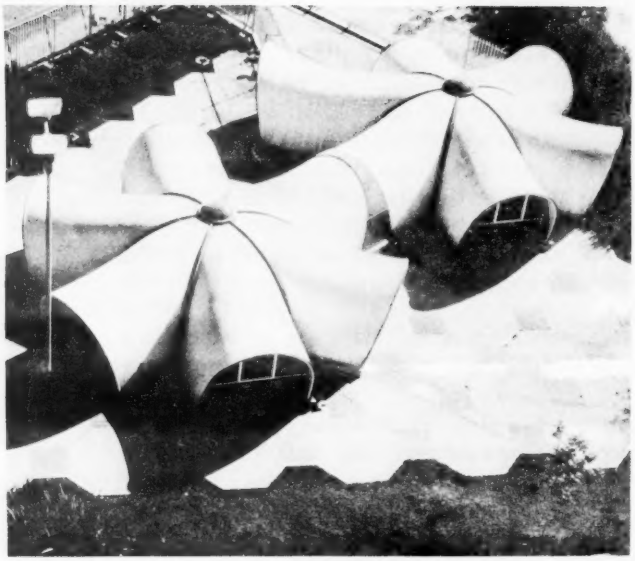
Specialist Services. From all clinics or treatment teams, complex cases and complications are referred to hospital centers, where specialists and adequate equipment are available to handle problems in any area of stomatology. In addition, we expect to build specialized centers with offices for outpatient consultations and rooms for simple surgery not requiring an operating room. The first of these will specialize in maxillofacial (upper jawbone) surgery, with one specialist, a maxillofacial surgery resident, and a staff of two clinical assistants. The cost per year of each maxillofacial center is about $18,650, with a coverage of 400 persons per team.

The New Philosophy

The program outlined above is bringing stomatological (mouth) care to people who have never before received it. In order to optimize local involvement in the programs, we are using attractive easy to read booklets to guide the people toward health services. For those who have little opportunity to read or are illiterate, pictures are used. Natural leaders who, with simple training, can organize their communities are encouraged to participate. Auxiliary personnel, basically composed of newly trained persons from the community itself, become part of the official oral care delivery system, along with laboratory and clinical technical staff working in specific areas under the supervision of stomatologists. And stomatologists, who in turn work in areas that require deeper knowledge, act as leaders of the oral health team.

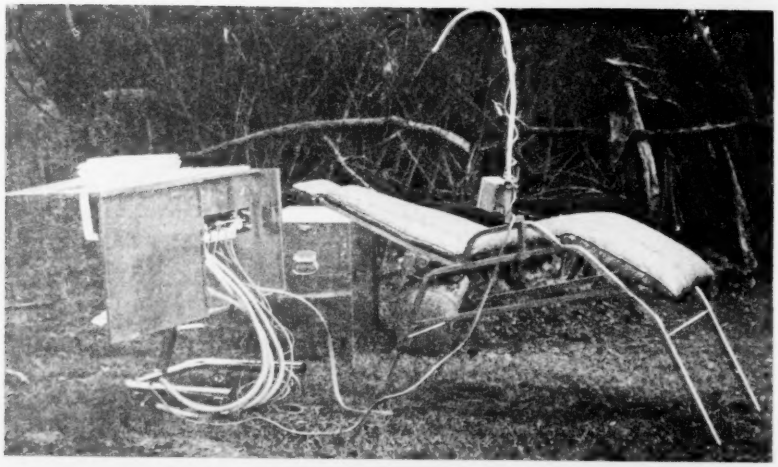
Thus, the stomatological programs currently under way in the State of Mexico reflect a new approach to care in marginal communities, new kinds of personnel training, and new ways to reach the public in need of dental care. This approach is beginning to gain acceptance at some universities, such as the Universidad Autonoma Metropolitana and E. N. E. P., Zaragoza, at least to the extent that dentists are being taught the value of working in teams with auxiliaries and the importance of extending prevention and care to wider elements in the population. Private dentists attacked the program, but their antagonism has diminished as they realized we are working with people who cannot pay private dentists anyway.

[Extracted from Chapter 3 of Proceedings of a Colloquium on International Dental Care Delivery Systems, John Ingle and Patricia Blair, editors. Published by the W. K. Kellogg Foundation, Battle Creek, Michigan, 1978.]



LEFT: A stationary urban dental care module in Nezahualcoyotl City, Mexico made up of two connecting prefabricated fiberglass buildings placed on a concrete base. One section is used as a waiting/teaching room and for administration, the other for dental care.

RIGHT: The center space in the module has one supply auxiliary who is responsible for tray arrangement and sterilization for the nine operating teams.



LEFT: Portable chair; self contained standardized equipment used in treatment in rural Mexico.

Dental Care in Venezuela and Ecuador

George M. Gillespie

[Over the past five years, new experiments in delivery of dental care have been initiated in Venezuela. Some features of the program are attention to local community attitudes, a year of national service for dental students, locally trained auxiliaries, and the development of low cost equipment. Ecuador is already building on the Venezuelan experience.]

An extensive survey of dental care facilities and needs in Venezuela was undertaken in 1966, based on 32,000 household interviews in 80 counties. Sixty-five percent of the population showed signs of peridontal disease, with higher proportions in low income groups. Dentists in private practice served largely the city residents with over $300 in income; 86% of what little dental care reached the rural areas was provided by government.

As a result of these findings, a new program for reform was launched in 1969. After consulting with communities selected through a sample in the national survey, the Dental Faculty at the University of Zulia in the city of Maracaibo made plans to open five clinics--or community laboratories, as they are called--in a four-state area. Each clinic served an area with different demographic characteristics, though none was more than an 11-hour drive from Maracaibo. In each community, the local administration was required to give evidence of interest, for example by donating a facility to house the clinic. Clinics have now been operating in the first four

Dr. Gillespie is the Regional Dental Advisor in the Division of Family Health of the Pan American Health Organization (regional branch of WHO with headquarters in Washington, D. C.).

areas for some years, but the clinic projected for Maracaibo city has not yet opened, due mainly to the need for additional financing.

When this program began, a major objective was to think of more appropriate ways to reach the local population, as well as to learn about their cultural patterns and attitudes. Consequently, dental staff associated with the new clinics took time to visit families wherever they were located. Surveys were developed in conjunction with a sociologist to ascertain community ideas about dental health and to get some impressions as to income and the stability of income, shopping habits, and sources of services. This way of involving the community in surveys clearly resulted in greater community interest once the clinics were opened.

Dental students were an integral part of the new program. In order to promote social awareness in them, the university required all students to spend their last year almost entirely outside the school of dentistry. They had to live in each community for at least six weeks, rotate through several different kinds of community experiences, and be responsible for their own food, housing, and participation in the community. Under faculty supervision, the students carried out the community surveys and undertook preliminary clinical examinations. Once the clinics were opened, a supervisor conducted inservice education programs in conjunction with the student clinical performance. Students were exposed to all phases of the system, including responsibility for administration, patient complaints, and other problems. One can see the impact of the community experience on the finished graduates. They are much more capable of producing total dental care for the population at large than those who graduate from a traditional school.

The community surveys had uncovered a clear need for specific dental services--e. g. 76 percent of the population examined needed tooth replacement. In addition to an improved system for providing relief-of-pain services, there was a need to provide greater emphasis on preventive and restorative care.

Since part of the idea was to look for new approaches to the use of auxiliaries, it was necessary to break down auxiliary personnel functions beyond the "classic" categories of dental hygienist, dental assistant, and dental nurse. An analysis of tasks identified some 35 functions that local high-school-age girls could be trained to perform. Training objectives were identified for each of these functions and training programs set up. It was soon evident that enough people would be willing to participate. The auxiliaries were trained efficiently and effectively, and could be rapidly incorporated into the intensive dental health education program for school children, to teach such basic functions as tooth brushing and oral hygiene. It is worth noting that, in a matter of three to four weeks, these girls

became extremely efficient in chairside assisting; in fact, they may now be proving to be the best teachers to instruct dental students in four-handed dentistry.

One of the problems faced was to break down the traditional barrier between the intramural faculty and the extramural experience. In the university clinic, dental students had been working under intense supervision, with traditional equipment and no chairside assistance; they were being trained to provide mainly a classic one-chair-one-operator relief-of-pain service. Now they were being exposed to working with auxiliaries and performing sit-down dentistry. In virtually the same space normally used by the old health-clinic system, a team was now able to work under the supervision of a dentist and coordinated by dental students. The student reaction was noteworthy: in a very short time they demanded that equipment at the university clinics correspond more to present-day dentistry, with anatomic-style chairs and other modern and functional equipment. Clinics in the Faculty of Dentistry, Maracaibo, have now been remodeled.

A major barrier to the implementation of rural health programs has been the difficulty of providing suitable low-cost equipment. Because of its extramural program, the Faculty at Zulia has been forced to establish criteria for such equipment and to develop a capacity to produce it. With the aid of the University Faculty of Engineering, simplified dental equipment has been developed which has the same function as most of the imported equipment used previously. For example, a simple dental chair made in the Faculty of Engineering costs about $200 to manufacture. The elimination of such unnecessary elements as water heaters for dental units and vertical movement in dental chairs has also helped to reduce costs. A rural clinic can now be established in a very short period of time at a minimum cost.

Experience in the Clinics

The first community laboratory was opened in 1970 in El Pedregal. In the early days, there was intense community interest and participation. A system of payment was devised through a survey conducted at the beginning of the program which identified three predominant income ranges; and three corresponding fee schedules were developed. Sixty percent of the population received service under one or another of the basic fee schedules in the first years. Then an increase in the permitted length of payment time brought a further 10 percent into the clinic; a small subsidy increased coverage by another 5 percent; and an intensive education program to reach those who weren't coming to the clinic increased coverage by another 10 percent. Thus, 85 percent of the population has been covered at one time or another.

Gradually, as more of the population came under a maintenance system, patient attendence tended to decrease.

In San Francisco, a marginally urbanized community, one-third of the population has been served since April 1976. Participation in San Felipe, an urban center, has hovered around 20 percent. In San Felipe, most patients are coming for fillings and other forms of maintenance care; but the other clinics are still performing large numbers of extractions, reflecting the greater numbers of first-time patients. Clearly, however, new ways need to be found to bring tooth replacement to the rural population; less than 2.0 percent of treatment at each clinic has involved dentures, although the baseline survey indicated that 70 percent of the adult population needed them. It has become apparent that the traditional system of five or six sittings to fit one denture is unacceptable for many people who must take time out from employment to visit the dentist and who may have problems of transportation to the dentist's office. It should be possible to work out a system whereby two or three stages can be completed at one period of time, so that the patient need only come back for the finished product.

Nationwide Impact

From the original experimental program started in 1970 these community-based programs have now spread throughout most of Venezuela, thanks to a national policy decision taken by the Ministry of Health. By 1977, 57 rural programs had been developed by the Ministry of Health, with 795 dentists involved. A separate budget for dental health has been established at the national level and the investment in dentistry increased.

There are some lessons here: First, the community must be involved from the beginning. This does not mean merely calling community leaders to the dental or administrative office to discuss provision of dental services; it means going out into the community and discussing matters of dental care, matters of daily life, and aspects of the local economy with a number of people. If change is to be effected, a mere increase in manpower is not enough; it is necessary to radically change the system of delivery. Use of auxiliary personnel is fundamental, as is the production of equipment at costs that can be readily afforded by the patients. And finally, there is a need to develop specific disease control programs directed to specific population groups, to utilize clearly defined education objectives for auxiliary personnel, and to develop specific guidelines for program implementation and evaluation.

Experience in Ecuador

The experience in Venezuela led the government of Ecuador to enter into a similar dental care program emphasizing rural areas, where 68 percent of the population lives. Ecuador's program is operated by the Ministry of Health. In 1971, it was estimated that there were 1,000 dentists and only 14 auxiliaries in this country, with one dentist per 3,000 urban population and one dentist to 60,000 in the rural areas. There were no preventive or community educational programs in dentistry, and rural dental care was extremely limited. In 1971, the Ministry of Health consolidated the providers of health services into four easily defined and readily identifiable institutions: the Ministry of Health, Social Security, Armed Forces, and private practice. A Division of Dental Health was created with responsibility for planning, implementing, supervising, and evaluating of national oral health programs; dental departments were also established in the 20 provinces of the country.

Preventive action was introduced in 1972 with a law requiring fluoridation. Some 31 cities, with a population of 2,243,419 persons, are now fluoridating their water supplies. Self-application fluoride programs in the home were started in 1975 and reached 53,000 children in 1976. Also, in 1975, a fluoride mouthrinse program for schools was begun with 63,000 children, which increased to 125,000 in 1976.

Following revision of the administrative structure, all dental graduates were required to provide one year of service to the health authorities. They became the basic manpower for the rural program's new "dental brigades", which grew from seven in 1972 to 22 brigades and 42 modules (106 dentists and 150 auxiliaries) in 1975. A brigade consists of two dentists and four locally recruited auxiliaries, who are taught basic functions of chairside assisting, dental prophylaxis, and prevention; all are employed by the Ministry of Health. Physical facilities are provided by the communities or, if not available, are built by the Ministry of Health. Dental care is provided free of cost to patients, with very simple equipment which nonetheless includes both high-speed and low-speed air turbines, together with vacuum suction. PAHO/WHO collaborated in providing technical assistance to the Ministry in establishing these systems and in equipment design.

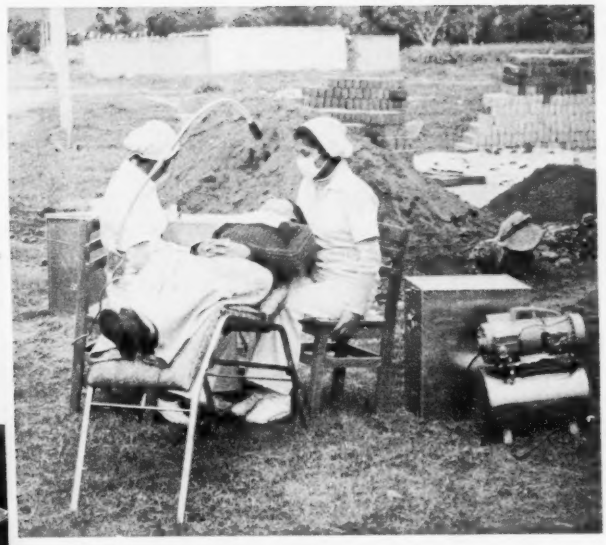
The original idea was that brigades would move from town to town. It soon became evident, however, that the rotating team produced little community participation. The system was then modified to provide "modules" of one dentist and two auxiliaries working in a fixed location and remaining permanently on the site. By 1976, 159 modules were functioning involving 159 dentists and 349 auxiliaries. Productivity targets have been set, so that each team, or module, is expected to complete treatment on 1,100 patients a year.

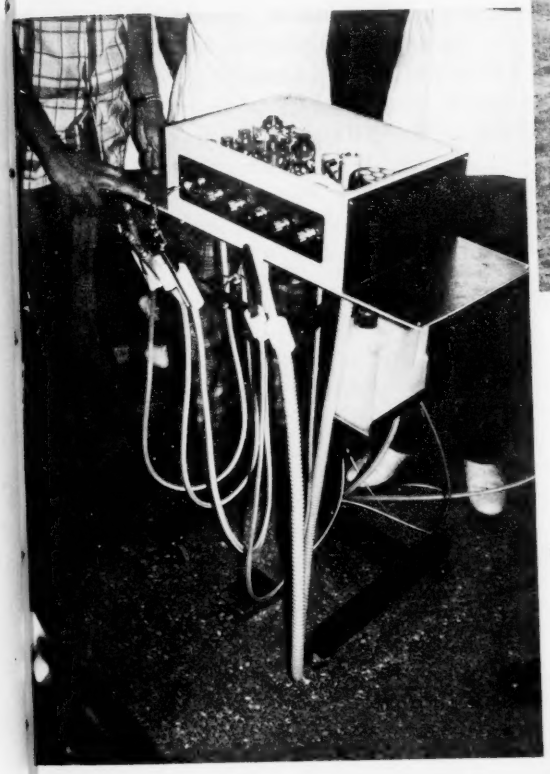
In urban areas, especially in the health centers and hospitals, the same concepts were applied. New systems of practice were initiated, and an increase of 106 dentists and 94 auxiliaries was obtained. Fifty-four hospitals were re-equipped.

Clearly the lessons drawn from the Venezuela experience apply in Ecuador as well. The result has been a dramatic increase in the distribution of rural dental services and improved urban dental services. The population with access to dental care increased from 130,065 in June 1972 to 1,542,600 in the first quarter of 1977. One of the most notable features of the system is that this large increase in service was accomplished entirely within the Health Ministry's budget which is little more than double what it was five years ago. The estimated cost per completed treatment for a child is 25 sucres, or about $1.00, and preventive (fluoridation) services are estimated at one cent for a 30-application, self-applied mouthrinse. The cost for equipment and instruments for one of the modules has been estimated at around $4,000, and investment in personnel at $34,000. Small health posts require an average investment of $2,000. Thus, in the rural situation in Ecuador, dental care can now be provided at a very realistic cost.

[Extracted from Chapter 3 of Proceedings of a Colloquium on International Dental Care Delivery Systems, John Ingle and Patricia Blair, editors. Published by the W. K. Kellogg Foundation, Battle Creek, Michigan, 1978.]

RIGHT: Remote area team operating at roadside in Mexico. Air pressure to operate handpieces, air and spray, as well as suction, is provided by compressor.





LEFT: PAHO developed dental unit for use in Latin America.

RIGHT: Ecuadorian dental team with a locally recruited auxiliary joined by a teacher. This dental clinic is a converted residence.

The Effect of Plaque Control— A Preventive Experience in Sweden

Jan Erik Ahlberg

[This article reports results of some recent research in Sweden on the effect of a plaque-control program on caries, gingivitis, and progressive periodontal disease. The research was carried out by Professor Jan Lindhe and Dr. Per Axelsson, and is of great significance in the worldwide fight against these diseases.]

The Trial Project with School Children

The first experiment was initiated in 1971 to test the hypothesis that dental caries and gingivitis will not develop in school children maintained on an oral hygiene program that includes meticulous paraprofessional tooth cleaning and oral hygiene instruction once every second week. Three age groups of Swedish children, 7-8, 10-11, and 13-14, all from the same school in Karlstad, were selected for the study. A preliminary examination was carried out, establishing indices of dental plaque, gingival (gum) inflamation, and dental caries for each child. The 216 children were then evenly and arbitrarily assigned into test and control groups. The 13- to 14-year-old children had all experienced a high caries attack rate--a "high-risk group". Over the four years under investigation, only five percent of the children were lost from the study per year.

The preventive program for the control groups included supervised toothbrushing once a month with a 0.2 percent sodium fluoride solution. The test-group children, on the other hand, were taught the use of toothbrush and dental floss, following plaque-staining with red dye disclosing tablets. More important for

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the result, all surfaces of the teeth were cleaned by specially trained dental assistants (prophy-dental nurses) every other week. Plaque was removed with an abrasive paste containing five percent monofluorophosphate. ["Dental plaque" is a mat of bacterial accumulation caught up in the sticky mucin of the saliva that adheres it to the teeth. These bacteria cause both dental caries and gingivitis.] Both dental floss and brushes were used interproximally, the latter in a special reciprocating handpiece. A regular rotary handpiece mounted with rubber cups or brushes was used on smooth or occlusal surfaces. For two years during the school year, paraprofessional tooth cleaning was carried out once every two weeks except during the three-month summer holiday, requiring about 10-15 minutes each time.

Caries. At the end of the first and second years, the test and control groups were re-examined. The results were startling. After one year, the children together in the test group had developed only six new carious lesions, while the same size control group had developed 300 lesions--50 times more decay. ["Caries", or carious lesions, are the infected cavities or holes in teeth; to halt infection, decayed matter must be removed, and the cavity filled.] At the end of two years, the experimentals had 19 new cavities and the controls over 600--30 times more. Over a three-year period, the 93 children in the test group developed a total of 42 new carious surfaces and the controls 790 new lesions--nearly 20 times more. In the four years of the study, the test group developed only 61 new carious lesions, whereas the controls developed 941--over 15 times as many cavities.

Plaque and Gingival Index. The same amazing difference became apparent in the plaque and gingival indices. ["Gingival" refers to the gums; gingival inflamation indicates an infection, causing gums to be swollen. Index scores are a way of measuring the severity of plaque or gingival inflamation.] A plaque index (PI) score of two indicates visible bacterial plaque at the neck of the tooth. Initially, over 20 percent of all the children, test and control, had such a plaque index score. After one and two years, however, less than one percent of the test-group children had a PI score of two, whereas the control-group children remained essentially the same as at their initial examination--around 20 percent. At the end of the third and fourth years, twice as many test children (70 percent) had all tooth surfaces free from plaque as did the control children (35 percent).

A low plaque index is associated with a low gingival inflammation score. After one and two years of paraprofessional tooth cleaning, not a single gingival unit among the test group was moderately inflamed (GI score--two). On the other hand, 10 percent of the gingiva of the control group remained severely inflamed; and by the end of three years, marked gingival inflammation involved 20 percent of all control-group gingival units.

During the third year of the study, the intervals between the sessions of paraprofessional tooth cleaning were extended from two weeks to four weeks for the younger children and to eight weeks for the 13- to 14-year-old "high risk" adolescents. During the fourth year, the intervals were prolonged to two months in groups one and two, and three to four months for group three--only three to four sessions a year. Even with this dramatic change the test groups maintained 70 percent of all permanent tooth surfaces free of dental plaque, whereas the controls did not improve from their initial examination four years before.

In the fourth and final year, the test-group children developed only 0.28 filled or decayed surfaces per child. Only one hour of prophylactic treatment [i. e. cleaning of teeth] per child per year was expended to achieve this result--and the cost was only 54 Swedish crowns, or about $13 per child. One full-time prophy-dental nurse could, in fact, almost completely prevent caries and gingivitis for 1,000 Swedish school children. Translated into 20 years of intact teeth with no periodontal disease, such a program (over 20 years) would require seven hours of diagnosis and orthodontic treatment by a dentist and 25 hours of preventive treatment by an auxiliary. The 20-year cost for such a program is around 2,600 Swedish crowns, or only $606 per person--$30 a year.

The Project with Adults

A second experiment, an investigation on adults, was carried out to determine if the occurrence of caries and the progression of periodontitis can be prevented in adults who are maintained at a proper oral hygiene standard by regular instruction and prophylaxis. An attempt was also made in the experiment to study the progression of dental diseases in individuals who received no special oral hygiene instruction but received regular dental care of a traditional type. Three different age groups of individuals from one geographic site were recruited in 1971-72 for the experiment. 330 were assigned to a test and 180 to a control group after learning the socio-economic status, the oral hygiene status, the incidence of gingivitis, and the caries experience of each; distribution of scores was similar in both test and control participants prior to the start of the study.

During the subsequent three-year period, the control patients were seen regularly once a year and given traditional dental care. The test-group participants, on the other hand, were seen once every two months during the first two years and once every three months during the third year. At each appointment, on an individual basis, they were instructed in proper oral hygiene technique and given a careful dental prophylaxis including scaling and root planing. Each prophylactic session was conducted by a dental hygienist. A re-examination was carried out toward the end of the third treatment year.

At the re-examination three years later, the oral hygiene status of all three test groups had markedly improved in comparison with the baseline data. Thus, the total mean plaque score had decreased from 62.4 percent to 17.4 percent (young adults, Group I), 61.9 percent to 19.1 percent (middle age, Group II), and from 63.0 percent to 17.8 percent (older, Group III). Such decreases in the plaque scores were statistically very significant (probability less than .001) for each group. In the control groups, there was no obvious improvement between the initial and final examination.

Concomitant with the improved oral hygiene of the three test groups at the re-examination, the gingival inflammation scores were markedly reduced. The frequency of inflamed gingival units had decreased from 22.2 percent to 1.7 percent (I), 20.6 percent to 1.3 percent (II), and 24.7 percent to 2.0 percent (III). The degree of improvement was similar in all three groups of patients, and again highly significant (probability less than .001). Following gentle probing during the observation period, gingival-bleeding scores of only one to two percent indicated that the test-group patients had clinically healthy gingivae, whereas there was no obvious improvement in the control groups in the number of gingival units that bled.

In the test groups, there was a significant reduction of clinical pocket depth between the baseline examination and re-examination. ["Clinical pockets" are inflamed tissues in the gum next to a tooth; the deeper they are in the gum, the worse the infection.] The mean pocket depths decreased from 2.0 to 1.5 mm (I), 3.1 to 1.4 mm (II), and from 3.2 to 1.5 mm (III). More important, in all age groups, the pocket-depth reduction was most pronounced in the interdental areas. In the control groups, there was a corresponding slight increase of pocket depth (I, 0.5 mm; II, 0.6 mm; III, 0.5 mm) between the two examinations.

Table 1: Summary of Findings on Preventive Dental Care Experiments

Children	Test Group	Controls
Caries:		
after 1st year	6	300
2nd year	19	600
3rd year	42	790
4th year	61	941
Gingival Inflamation (severe):		
1st and 2nd year	0	10%
3rd year	0	20%

Adults	young adults	middle aged	older
Plaque Index:			
Test Group: before test	62.4	61.9	63.0
3rd year	17.4	19.1	17.0
Controls -	no change		
Gingival Inflamation Index			
Test Group: before test	22.2	20.6	24.7
3rd year	1.7	1.3	2.0
Controls -	no change		
Clinical Pocket Depth			
Test Group: before test	2.0	3.1	3.2
3rd year	1.7	1.4	1.5
Controls: change	+0.5	+0.6	+0.5
New Caries per person after 3 years: Test Group		0.1	
Controls		8.3	

The results with regard to adult caries were similar to those in the children's study. The control groups developed 8.3 decayed and filled surfaces per individual in three years; among the adults in the test group, however, practically no new carious lesions developed, only 29 new caries in 330 subjects (0.1 per person) during the three-year trial period. Furthermore, no cases of enamel or cementum erosion were reported due to professional cleaning, though some had predicted this would be the case. The cost per adult patient for this treatment in Sweden was around $40 per year--the income of a hygienist working two to three hours per patient per year.

Conclusions

How can such striking differences occur through mechanical plaque control, by which Lindhe and Axelsson mean a comparison of para-professional tooth cleaning with tooth cleaning carried out at home? The answer is, first, the more frequent complete removal of the dental plaque; and beyond that, the impact of the motivation derived from the comfortable feeling of completely clean teeth acquired through comfortable treatment. With individual success, the patients try to maintain this clean feeling; they do not become slothful in their personal oral hygiene between prophylactic visits, as one might expect.

Swedish scientists are usually, and quite rightly, cautious about drawing conclusions that are not entirely supported by firm scientific evidence. In my position, however, I feel justified in making some bold and even provocative statements to bring about discussion.

On the basis of the assembled mass of experience from the delivery system and clinical field trials in Sweden, I would state the following:

a) The investigations of Lindhe and Axelsson demonstrate that every person responsible for planning oral health care delivery must, first of all, include disease prevention by means of plaque control as the very basic concept of any delivery system.

b) Efficient plaque control can be managed with the aid of auxiliaries, who need only limited training. In the above study, the chair-side assistants needed only five or six weeks of special training. In the words of Axelsson, however, they should be "well motivated, responsible, and skillful."

Some conclusions have relevance primarily for the industrialized countries. Among these are that:

c) Reparative/prosthetic treatment is time-consuming, demanding in manpower, and therefore expensive. It also produces a limited reduction, if any, in the volume of oral diseases.

d) Plans to introduce dental health insurance schemes based primarily on financing (subsidizing) reparative treatment, or to introduce new categories of operating auxiliaries with mainly reparative functions, are based on priorities that may have seemed relevant 10 to 15 years ago but are of doubtful value today.

e) The most useful categories of auxiliaries to bring about plaque control, and thereby disease prevention, are the two most commonly found in the industrialized countries--namely, the dental (chairside) assistant and the dental hygienist. The application of mechanical plaque control in the dental office does not require sophisticated facilities, and its complete success is closely related to the motivation of the individual. Plaque control would, therefore, seem to be easily adaptable to many different systems of delivery without great interference in their present general structure.

In developing countries, where a dental delivery system may hardly exist, an adequate solution might involve a mixture of different approaches. One hundred years ago, Sweden was almost a developing country as far as dentistry was concerned. Since then, dentistry has passed through three main stages of development: (a) relief of pain; (b) replacement of lost teeth; and (c) a reparative stage; now it is entering into (d) the fourth, or preventive stage. The scarcity of resources and rapid increase in oral diseases may emphasize that present-day developing countries, while of necessity alloting resources to stages one and two, should preferably try to bypass stage three and jump directly to stage four.

[Extracted from Chapter 6 of Proceedings of a Colloquium on International Dental Care Delivery, John Ingle and Patricia Blair, editors. Published by the W. K. Kellogg Foundation, Battle Creek, Michigan, 1978.]

Dental Care in the People's Republic of China

John I. Ingle

[China's 900 million people are served by a very small proportion of professionally trained dentists; dental care for the great majority is supplied by numerous "dental health workers" and "dental technicians" with no widespread preventive programs.]

Delivery of health care, and particularly dental care, in China is closely tied to the distribution of its massive population. Eighty percent of China's population is rural; most of it is grouped in 70,000 communes, with populations ranging from 10,000 to 80,000 each. The remaining 20 percent of the population is crowded into cities, with Shanghai (population 12 million) the largest. This demography makes collectivization of dental care feasible as well as politically desirable.

Chinese Arrangements for Dental Service

Dental Health Workers and Barefoot Doctors. One of the most creative Chinese post-revolutionary innovations was to develop a new class of paramedical worker, the "barefoot doctor", trained to deliver care at the production-brigade level. It is estimated that over 800,000 of these paramedics are presently functioning in China. The dental counterpart of the barefoot doctor is the "dental health worker", often a converted rural dental "empiricist" who formerly worked in the streets, now further trained and brought indoors to care for a community's dental needs. Treatment, of course, is limited by the restriction of training, but the dental health worker is able, as

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before, to extract teeth (now with the advantages of procaine or acupuncture analgesia), as well as to place fillings and preformed stainless crowns. Some dental health workers are trained to make dentures, but they do not undertake bridgework, orthodontic, periodontic, or endodontic treatment, or any major oral surgery.

On my 1973 visit to China I saw dental care being delivered at one commune, with 26,000 peasants, by two men using one ancient chair and a tiny laboratory. An old-fashioned handpiece powered by a foot-treadle was being used. The cuspidor was a blood-encrusted bucket on the floor. The dental worker on duty was the son of a village tooth-puller; he had learned this "skill" from his father but had also had six months of additional training at the dental clinic attached to the county hospital. At another commune, three dental workers cared for 70,000 peasants. They had been trained in six months by a member of the University of Peking College of Stomatology who had been "sent down to the countryside for re-education" during the Cultural Revolution of the late 1960s. These peasants practiced general dentistry with no apparent age priorities. They claimed they completed an average of 10 full upper and lower dentures every week. The third commune dental facility was staffed by a male-female team, with the woman in charge as the dental worker and the male as her assistant, called a dental nurse.

The barefoot doctors also deliver some dental care in remote regions where no dental workers are available. Each is equipped with a tooth-extraction kit. After three months to a year of health care training, the barefoot doctor is sent into the field with a manual that, among other things, illustrates how to make oral injections and extract root tips. The manual also illustrates how to perform tubal ligations, deliver babies, perform appendectomies, and repair facial clefts. All of these health workers--the barefoot doctors and dental health workers--often return to their county or provincial centers for refresher and further training programs.

Dental Technicians. The next level of dental care personnel, more technically trained than the dental health worker, is the dental technician. These technicians are trained for six months to a year in dental "schools". At the end of their training, they are qualified, by Chinese standards, to deliver general dental care--simple restorative and periodontal work, root-canal therapy, full denture prosthetics, and simple extractions. It would appear that most serve an "internship" in clinics, under the supervision of a stomatologist, before serving on their own. They are backed up by dental nurses and laboratory technicians, however, and are expected to return periodically for refresher courses. The Chinese have not released figures on the number of dental technicians presently practicing in China, nor stated how many dental schools are in the country. But there are said to be 10 schools in Shanghai alone; it would appear that these dental technicians are delivering the bulk of China's general dental care.

The Stomatologists. Education in western-style dentistry, or stomatology, has grown very slowly in China since its beginning in 1916. Today, there are only five faculties graduating dentists to serve some 900 million people. Chinese stomatologists (as they prefer to be called) serve primarily as the administrators of dental care delivery programs, overseeing the practicing dental technicians. In addition, stomatologists serve as the diagnosticians of complex cases and as oral, maxillofacial, and plastic surgeons; they plan and oversee orthodontic treatment, and carry out complex restorative, fixed prosthodontic, periodontic, and endodontic procedures; and, of course, they teach students.

Stomatologists also have major responsibility for most dental care delivered in large clinics called Dental Prevention and Treatment Centers. Again, it is not known how many of these centers there are. Each Dental Prevention and Treatment Center has four divisions: children's dentistry, adult dentistry, oral surgery, and prevention which involves schools and home care. Dentists head each section. One center visited in Manchuria had a professional staff of 75 people (65 of them were females) made up of 10 stomatologists and 65 dental technicians. The director was a female stomatologist--though the inevitable Vice Chairman of the Revolutionary Committee, not a dentist, was a male.

There do not appear to be dental clinics in the primary or secondary schools or dental facilities in the small neighborhood health clinics. Every hospital in China seems to have an outpatient dental service, however, and some of the secondary and tertiary health centers have inpatient dental services as well as clerks, sterilizing personnel, porters, and cleaning persons. The hospital associated with a huge iron-and-steel collective in An Shan, Manchuria, is typical. There is a professional staff of seven--five stomatologists and two technicians--to man the outpatient and inpatient services. They see over 100 patients a day. The director of the dental service, which was attached to the eye, ear, nose, and throat service, was a very sophisticated self-trained oral surgeon, who spoke English very competently even though he had never been outside China.

Compensation. Compensation for dental personnel appears to be fairly well standardized nationwide. Lower-level personnel are paid about the same as the peasants and barefoot doctors--35 to 40 yuan monthly (one Chinese yuan is equal to about half a U. S. dollar). All second-level dental workers have the privilege of escalating from their positions to higher levels, if recommended by their fellow workers. With more education, dental nurses and "workers" may move up to technicians, technicians to stomatologists, and general stomatologists into the dental specialties.

Health-science specialists are among the elite in a society claiming to be proletarian. They receive higher salaries and perquisites such

as: chauffeured transportation, better housing, the right to hire servants, etc. The dental specialist salaries appear to range from 200 yuan a month up to 340 yuan for the dean of a dental school; medical salaries are comparable. Many professional families have a combined income of as much as 400 yuan a month. Out of this, they pay perhaps seven yuan for a three-bedroom apartment with utilities, about 15 yuan monthly for food for each, and 40 yuan a month for an "aunty", a housemaid who appears to be one of the few examples of private enterprise in China. A family of four with a maid might, therefore, spend about 110 yuan a month out of 400 yuan income. The remaining 290 yuan could be used to buy clothes, bicycles, television, radio, even a piano, and eventually a camera (no one but the State may own an automobile, however). Part of savings is banked, at 2.5 percent interest, for vacations and out of habit.

Payment for Health Services. China uses the following system of payment for health services rendered: "labor-medical insurance" (LMI) for factory workers, and "cooperative medical services" (CMS) for the rural peasants; CMS is voluntary. There is a standard fee schedule used nationwide by government clinics and hospitals. When the patient's dental work (or hospital stay) is completed, the patient pays the fee and is given a chit which he turns in to CMS at his commune or LMI at his collective. He is then compensated by the organization according to their program--some at the rate of 100 percent of what he paid, others at 80 percent. Dental fees for the peasants appear to be at half fee, one of the perquisites (such as free housing and food for half cost) to improve the lot of the rural workers.

Each month, every worker or peasant pays 10 to 20 fen (like 5 to 10 cents) into the collective health care fund, which is then used to compensate those who utilize the system. Dependents have to pay half of their health care charges; they often wait until they become ill before joining the collective fund. Government workers, soldiers, students, and retired persons are treated free in government clinics. The Chinese are willing to work on foreigners using the same fee schedule. I observed a visiting Indonesian (Chinese) school teacher, for example, who received a full upper denture over a cast lower partial for only 22 yuan (U.S. $11.00), a tenth of what it would have cost in Jakarta. The quality was excellent.

Dental Education

In 1972, education for a stomatologist (and a physician) was limited to three years. Initial requirements for entry are graduation from "high school" followed by service of two years "in the countryside" or as a member of the armed forces, a factory worker, or barefoot doctor. Prior to 1968 the courses in stomatology or medicine were six years; universities were closed during the Cultural Revolution,

and re-opened with new curricula that reduced required course time by 50 percent. Some discontent with the shortened curriculum has been voiced, and one has a feeling that four years may be the eventual compromise. There has been a tightening of testing procedures recently and a greater emphasis on teaching basics, both of which became slipshod following the Cultural Revolution.

There are five faculties of stomatology in China, all associated with medical colleges. All told, there may be about 1,500 students of stomatology in China, with 500 entering and graduating each year, about one tenth of the corresponding numbers of medical students. If it were not for the reconstituted village tooth-pullers and acupuncturists and the lesser-trained dental technicians, most Chinese people would receive no dental care.

Incidence of Dental Disease in China

To the untrained eye, the Chinese appear to have "great teeth". Upon closer examination, however, one notices a high incidence of periodontal disease in adults and a good many missing posterior teeth. Older Chinese proudly exhibit anterior gold crowns. There is absolutely no official information coming out of China concerning the prevalence of dental disease or the results of treatment, and I can only offer a few personal observations.

In 1973, I had the opportunity to examine casually 32 seven-year-old children in a Shanghai school. My impression was that over half had severe caries, a number with alveolar abcesses. Many were rapidly developing gingivitis from their poor oral hygiene. None of the permanent first molars or incisors appeared to be decayed, however. My findings appear to parallel those of Dr. Reginald Louie of the U.S. Public Health Service in 1975, the only other Western dentist to have reported such observations.

At the same Shanghai school complex, I was also able to examine 49 fourteen-year-olds, 18 girls and 31 boys. The contrast between these youngsters, with permanent teeth, and the young children in the first grade was startling. The 14-year-olds had virtually no caries. The only missing teeth (there were a few remaining primary teeth) were congenitally missing or premolars extracted because of dens evaginatus, of which there is a 2.2 percent incidence reported in orientals generally. The incidence of gingival debris and caries was only slightly less in the 14-year-old girls than in the boys.

Mild gingivitis forecast the future periodontal problems apparent in adult Chinese. Kwangchou is apparently the only Chinese city with part of its water supply fluoridated. Since Shanghai does not fluoridate its water supply, the mottling I noted of some of the teeth of the

14-year-olds might indicate the presence of natural fluorine in the water supplies. Each child had been born in Shanghai, most within the First Shanghai Workers' Village, where the schools were located. Mottling was not found in the first-grade children.

The wide disparity in caries incidence between primary and permanent teeth in Chinese children calls for some explanation. Dr. Louie has suggested that it might result from a packaged mix of powdered milk, sugar and other ingredients that many parents give their very young children. This glaring difference between primary and permanent teeth has been noted in other oriental populations as well, but the explanation remains obscure.

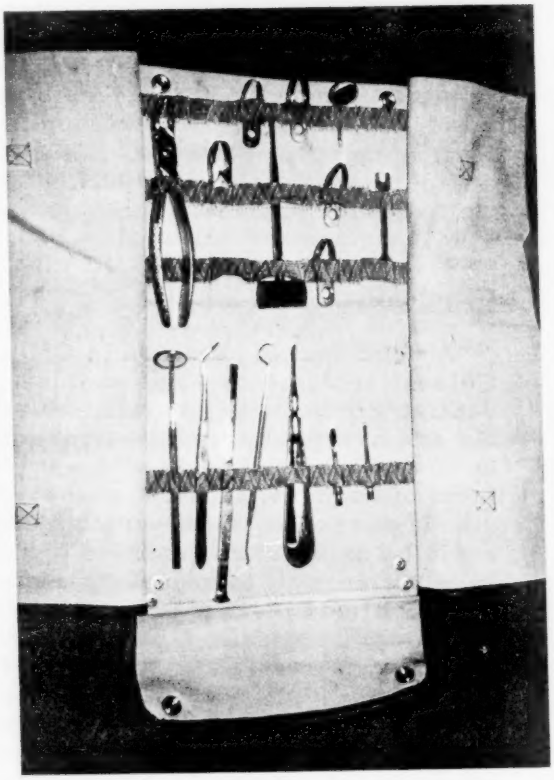
Conclusions

A good deal of attention in China is directed to applying traditional Chinese treatments--acupuncture, herbal concoctions, etc. --to dentistry. In no way is this a substitute for the impact a well thought out and executed prevention program would have. China has not lived up to her potential in dentistry. With the rigid controls and the high level of cooperation that are the norm among Chinese people, it stands to reason that a very effective dental prevention program could be mounted and carried out in the school systems. That they have not seen fit to undertake a massive program in prevention probably reflects the low priority the Chinese people seem to place on retaining their teeth.

China has unquestionably chosen the proper course in the delivery of dental care, however. The government has learned that there is no need to pay professionals 200 yuan a month to carry out uncomplicated dental procedures when someone can be trained in a fraction of the time and paid 50 yuan to do the same thing just as well. Sophisticated Chinese practitioners are saved for sophisticated procedures, as well as for management. This may be the lesson some of the other developing nations could learn from China.

[Extracted from Chapter 5 of Proceedings of a Colloquium on International Dental Care Delivery Systems, John Ingle and Patricia Blair, editors. Published by the W. K. Kellogg Foundation, Battle Creek, Michigan, 1978.]

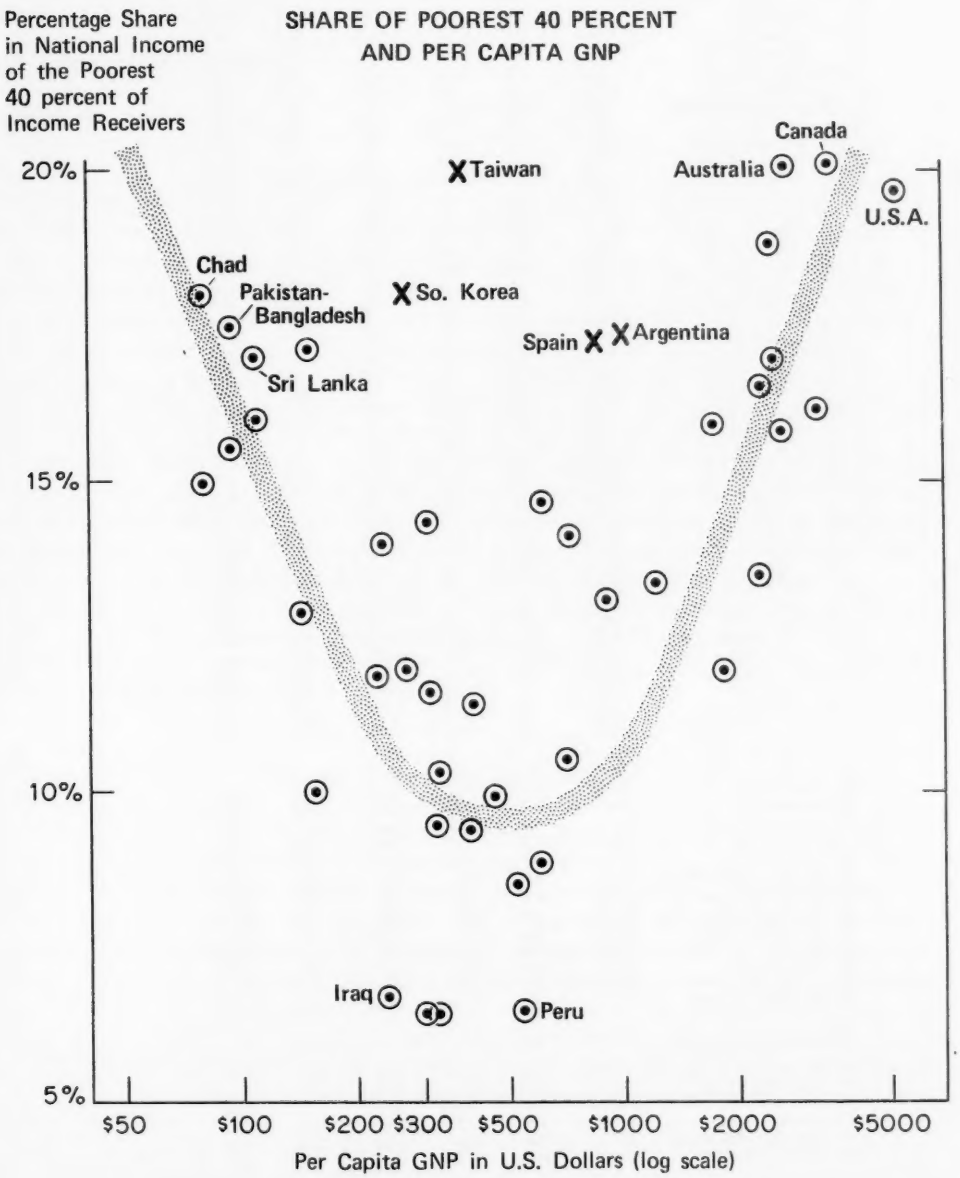
LEFT: Chinese dental health worker with treadle drill.



RIGHT: Chinese barefoot doctor's dental kit for extractions at remote sites. Kit contains six forcep beaks, four elevators, chisel, and mallet.

LEFT: Third year student stomatologists practicing in Shanghai dental college pedodontic clinic. Parents not only accompany children to the chair but serve as assistants as well.

INCOME DISTRIBUTION TRENDS



Each point on this graph represents a country in a particular year, using data from the table on the next page. A few countries are named: those with extreme values on the curve, and those with unusual values (Taiwan, So. Korea, Spain, Argentina). Socialist countries are omitted. The U-shaped curve is drawn to illustrate the trend; it is not a mathematically defined curve.

INCOME DISTRIBUTION AT DIFFERENT LEVELS OF DEVELOPMENT

Country	Per capita GNP in US$ (1970 prices)	Income shares of quintiles: Bottom 20%	Second quintile	Third quintile	Fourth quintile	Top 20%
Developing countries						
1. Chad 58 (1)	79.5	7.5	10.5	17.0	22.0	43.0
2. Malawi 69 (1)	80.0	5.8	9.1	13.3	18.6	53.2
3. Dahomey 59 (1)	91.3	5.0	10.5	14.5	20.0	50.0
4. Pakistan 63–64[a]	93.7	6.5	11.0	15.5	21.5	45.5
5. Tanzania 67 (1)	103.8	5.0	9.0	12.0	17.0	57.0
6. Sri Lanka 69–70 (3)	108.6	6.0	11.0	16.5	20.5	46.0
7. India 63–64 (4)	110.3	5.0	11.0	13.0	19.0	52.0
8. Malagasy 60 (1)	138.7	5.5	8.0	9.5	16.0	61.0
9. Thailand 62 (1)	142.8	5.7	7.2	11.9	17.5	57.7
10. Uganda 70 (1)	144.3	6.2	10.9	13.9	21.9	47.1
11. Kenya 69 (1)	153.2	3.8	6.2	8.5	13.5	68.0
12. Botswana 71–72 (1)	216.6	1.0	5.9	14.5	19.7	58.9
13. Philippines 65 (1)	224.4	3.9	7.9	12.5	20.3	55.4
14. Egypt 64–65 (1)	232.8	4.2	9.8	15.5	23.5	47.0
15. Iraq 56 (1)	235.5	2.0	4.8	9.2	16.0	68.0
16. El Salvador 61 (1)	267.4	5.5	6.5	8.8	17.8	61.4
17. Korea 70 (5)	269.2	7.0	11.0	15.0	22.0	45.0
18. Senegal 60 (1)	281.8	3.0	7.0	10.0	16.0	64.0
19. Honduras 67–68 (1)	301.0	2.0	4.4	9.1	19.5	65.0
20. Tunisia 70 (2)	306.1	4.1	7.3	12.0	21.6	55.0
21. Zambia 59 (1)	308.2	5.6	9.0	11.9	16.5	57.0
22. Ecuador 70 (1)	313.6	2.5	3.9	5.6	14.5	73.5
23. Turkey 68 (1)	322.2	3.0	6.5	11.1	18.8	60.6
24. Ivory Coast 70 (2)	328.7	3.9	6.2	11.8	20.9	57.2
25. Guyana 55–56 (1)	350.8	4.0	10.0	16.8	23.5	45.7
26. Taiwan 68[b]	366.1	7.8	12.2	16.3	22.3	41.4
27. Colombia 70 (7)	388.2	3.5	5.9	12.1	19.1	59.4
28. Malaysia 70 (3)	401.4	3.4	8.0	12.6	20.1	55.9
29. Brazil 70 (4)	456.5	3.1	6.9	10.8	17.0	62.2
30. Jamaica 58 (1)	515.6	2.2	6.0	10.8	19.5	61.5
31. Peru 70 (4)	546.1	1.5	5.0	12.0	21.5	60.0
32. Lebanon 55–60 (1)	588.3	5.0	8.0	10.0	16.0	61.0
33. Gabon 68 (2)	608.1	3.3	5.5	7.9	15.8	67.5
34. Costa Rica 71 (2)	617.1	5.4	9.3	13.7	21.0	50.6
35. Mexico 69 (5)	696.9	4.0	6.5	9.5	16.0	64.0
36. Uruguay 67 (1)	720.8	4.3	10.0	15.1	23.2	47.4
37. Panama 69 (2)	773.4	2.9	6.5	12.5	18.8	59.3
38. Spain 64–65 (1)	852.1	6.0	11.0	15.7	22.1	45.2
39. Chile 68 (1)	905.5	4.5	8.5	12.7	17.5	56.8
40. Argentina 61 (1)	1004.6	7.0	10.3	13.1	17.6	52.0
41. Puerto Rico 63 (1)	1217.4	4.5	9.2	14.2	21.5	50.6
Developed countries						
42. Japan 68 (2)	1712.8	4.6	11.3	16.8	23.4	43.8
43. Finland 62 (1)	1839.8	2.4	8.7	15.4	24.2	49.3
44. Netherlands 67 (2)	2297.0	3.1	10.5	16.4	21.5	48.5
45. France 62 (1)	2303.1	1.9	7.6	14.0	22.8	53.7
46. Norway 63 (1)	2361.9	4.5	12.1	18.5	24.4	40.5
47. United Kingdom 68 (2)	2414.3	6.0	12.8	18.2	23.8	39.2
48. New Zealand 70–71 (3)	2501.5	4.4	12.5	18.6	23.5	41.0
49. Denmark 63 (1)	2563.9	5.0	10.8	16.8	24.2	43.2
50. Australia 67–68 (1)	2632.4	6.6	13.5	17.8	23.4	38.7
51. Germany, W. 70 (2)	3208.6	5.9	10.4	15.6	22.5	45.6
52. Canada 65 (1)	3509.6	6.4	13.6	16.5	23.3	40.2
53. Sweden 70 (2)	4452.2	5.4	9.9	17.6	24.6	42.5
54. United States 70 (3)	5244.1	6.7	13.0	17.4	24.1	38.8
Socialist countries						
55. Bulgaria (1)	406.9	9.8	15.2	18.0	22.0	35.0
56. Yugoslavia 68 (2)	602.3	6.5	12.0	17.0	23.0	41.5
57. Poland 64 (1)	660.8	9.8	13.6	18.1	22.5	36.0
58. Hungary 67 (1)	872.7	8.5	15.5	19.0	23.5	33.5
59. Czechoslovakia 64 (1)	887.7	12.0	15.6	19.0	22.4	31.0
60. Germany, E. 70 (1)	2046.3	10.4	15.8	19.8	23.3	30.7

[a]The income distribution for Pakistan is for East and West Pakistan taken together.

SOURCE: Shail Jain, Size Distribution of Income, a compilation of data. A World Bank Publication, 1975.

Inequality, Poverty and Development

Montek S. Ahluwalia

[This article explores statistical relationships affecting the shares of different groups in total national income--the poorest 20%, 40%, and 60%, the middle 40%, and the top 20%. One important result is the "U-curve" (see chart on page 101) indicating higher shares for the poorest groups in the lowest income countries (below $150), then decreasing shares for these groups as one moves to countries with higher average income per capita, but with their shares increasing again as one moves on to still higher income countries (above $1,000). If the process of development is seen as movement from lower to higher average income levels, the U-curve suggests that income distribution becomes more unequal at earlier stages of development, i. e. the rich gain proportionately more from progress than the poor; but that this trend reverses beyond a further stage of development so that the poor tend to gain proportionately more than the rich. Other findings described here concern the effects on income distribution of: a spread of literacy (helps the poor, relatively), and of secondary education (helps middle groups); of decreased rates of population growth (equalizing); and of rural-urban shifts (equalizing in some ways).]

The relationship between the distribution of income and the process of development is one of the oldest subjects of economic enquiry, starting with classical economic theory. In recent years it has again come to occupy the center stage of development economics. The purpose of this paper is to explore the nature of this relationship on the basis of cross country data on income inequality. Ideally, development processes should be examined in an historical context for particular countries, but time series data on the distribution of income are simply not available over any substantial period for most

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developing countries. For the present, therefore, empirical investigation in this field must perforce draw heavily on cross country experience.

The results presented in this paper are based on a recent World Bank compilation of income distribution in 60 countries including 40 developing countries, 14 developed countries and 6 socialist countries (see table on page 102). These data give the shares in national income going to the poorest 20% of population, the share of the next 20% or quintile, on up to the richest quintile. We have used multivariate regression analysis to estimate cross country relationships between the income shares of different percentile groups and selected variables reflecting aspects of the development process which are likely to influence income inequality. The estimated equations are then used as a basis for generalizations about the relationship between income distribution and development. The difficulties inherent in this methodology are well known: the relationships thus identified are primarily associational. They do not necessarily establish the nature of the underlying causal mechanisms at work; when different causal mechanisms might generate the same observed relationship between selected variables, our estimated equations do not always permit us to choose among them. The cross country relationships presented in this paper must be viewed in this perspective. We should treat them as "stylized facts", phenomena which can be observed but which need to be explained by an appropriate theory. Nevertheless, the observed relationships may suggest hypotheses about the nature of the underlying causal mechanisms at work, which could be further tested and fashioned into a broader theory. They could also provide yardsticks for verifying theories of distribution and development by defining aspects of observed behavior that such theories must explain.

A logical point of departure for our investigation is the hypothesis, originally advanced by Simon Kuznets (1955, 1963), that the secular behavior of inequality follows an inverted 'U-shaped' pattern with inequality first increasing and then decreasing with development. Following Kuznets, the proposition that the distribution of income worsens with development, at least in the early stages, has received considerable attention. More recently it has been advanced in a much stronger formulation, which states that the process of development may actually lead to the absolute impoverishment of lower income groups. These issues, together with several others, are examined here.

Kuznets' hypothesis: The U-shaped curve

We begin by documenting the evidence for Kuznets' hypothesis that inequality tends to widen in the early stages of development, with a reversal of this tendency in the later stages. Following

convention, we have tested this hypothesis by taking the per capita GNP of each country (in US$ at 1965-71 prices) as a summary measure of its level of development, and including it as an explanatory variable in regression equations in which the income share of different percentile groups is taken as the dependent variable.

Table 1
The Kuznets curve.

Dependent variable	Estimated coefficients on explanatory variables[a]							
Income shares of:	Constant	Log per capita GNP	[Log per capita GNP]^2	Socialist Dummy	R^2	F	D.W.	Turning point per capita GNP US$ (1965-71)
(A) Full sample								
(1) Top 20 percent	−57.58	89.95	−17.56	−20.15	0.58	27.9	2.05	364
	(2.11)	(4.48)	(4.88)	(6.83)				
(2) Middle 40 percent	87.03	−45.59	9.25	8.21	0.47	18.6	2.08	291
	(4.81)	(3.43)	(3.88)	(4.20)				
(3) Lowest 60 percent	119.4	−73.52	14.06	17.52	0.61	31.4	1.97	412
	(5.85)	(4.90)	(5.23)	(7.95)				
(4) Lowest 40 percent	70.57	−44.38	8.31	11.95	0.59	29.8	2.04	468
	(5.38)	(4.61)	(4.82)	(8.45)				
(5) Lowest 20 percent	27.31	−16.97	3.06	5.54	0.54	24.3	1.93	593
	(4.93)	(3.71)	(3.74)	(8.28)				
(B) Developing countries only								
(1) Top 20 percent	−99.74	123.80	−24.18		0.12	3.6	2.24	363
	(1.50)	(2.35)	(2.26)					
(2) Middle 40 percent	92.93	−49.13	9.65		0.01	1.4	2.19	351
	(2.12)	(1.36)	(1.32)					
(3) Lowest 60 percent	171.50	−116.40	22.72		0.22	6.5	2.20	364
	(3.79)	(3.12)	(2.99)					
(4) Lowest 40 percent	106.80	−74.69	14.53		0.24	7.2	2.20	371
	(3.83)	(3.25)	(3.10)					
(5) Lowest 20 percent	44.15	−31.33	6.07		0.22	6.3	1.98	381
	(3.43)	(2.96)	(2.81)					

[a] t-statistics in parentheses.

The cross country regressions provide substantial support for the U-shaped pattern in the secular behavior of inequality. Table 1 reports the estimated equations describing the relationship between income shares of five different percentile groups (the top 20 percent, the next or 'middle' 40 percent, the lowest 60 percent, the lowest 40 percent and the lowest 20 percent) and the logarithm of per capita GNP. Two equations are reported for each income share, one estimated from the full sample of 60 countries and the other estimated from the restricted sample of 40 developing countries only. For the full sample, we have included a dummy variable for the socialist countries in order to take account of the much higher degree of equality observed in these countries. The results obtained can be summarized as follows:

(1) Taking the results from the full sample to begin with, there is clear evidence of directional shift in the relationship between inequality and the level of developement. The equations test a quadratic relationship with the logarithm of per capita GNP: in all cases, both terms of the quadratic are significant and the coefficients have the

appropriate opposite signs to generate the U-shaped pattern hypothesized by Kuznets. Income shares of all percentile groups except the top 20 percent first decline and then increase as per capita GNP rises. Income shares of the top 20 percent display a corresponding opposite pattern. (Throughout this paper the term significant will be used to indicate that the estimated coefficients are significantly different from zero with the sign indicated at least at the 10 percent level for a two-tailed test. The critical value of t for this level of significance is 1.68 for our sample size.)

(2) The turning points for income shares implied by the estimated equations are also reported in table 1. It is interesting to note that this turning point occurs at different levels of per capita GNP for different income groups. In the case of the full sample, the turning point for the income share of the top 20 percent occurs at per capita GNP levels of US$ 364 (for the economy as a whole) after which the income share of this group begins to decline. However, the income shares of the middle 40 percent appear to improve after a per capita GNP level of only US$291 is reached. As shown in table 1, the turning point of income shares shifts systematically further out as we go down the percentile groups, with the lowest 20 percent having to wait until per capita GNP levels of about $600 are reached. Taking these estimates at face value, the evidence suggests that the reversal of the "deteriorating phase" of relative inequality begins at a fairly early stage in the growth of income levels, first for the middle income group but much later for the lower income groups. It appears that if there is a "trickle down" process, then it takes substantially longer to reach the bottom!

(3) The basic pattern described in (1) and (2) above can also be discerned in the equations estimated from the restricted sample of 40 developing countries, with slight differences.

(4) A major problem in interpreting the U shape revealed in cross country data is the possibility that it may be generated solely by the fact that the middle income range is dominated by countries with particular characteristics which generate high inequality. If so, the U shape will have little relevance to the long-term prospect facing the low income countries of today unless these countries are likely, at a later stage of their development, to share the same disequalizing characteristics. Thus, it is sometimes argued that the U shape simply reflects the concentration in the middle income range of Latin American countries, which display greater inequality because their particular history gave them structural characteristics not applicable to others. We have tested for this "Latin America effect" by including a dummy variable for the Latin American countries in each of the equations A. 1 to A. 4. We find that the coefficient on this dummy variable is insignificant in all cases, and its inclusion leaves both the sign pattern and the significance of the coefficients on the income quadratic largely unaffected. Similarly, Gustav Papanek

(1976) has argued that the observed U shape disappears when certain "strongly dualistic" countries are excluded from the sample. We note, however, that our sample excludes South Africa, Rhodesia, Libya, Niger and Trinidad, five of the seven dualistic cases identified by Papanek, and we still find significance for the U shape.

These results are broadly in line with earlier findings of Adelman and Morris (1973) and Chenery and Syrquin (1975), indicating a marked decline in the relative income shares of the lower income groups in the early stages of development; they also suggest that the decline is most prolonged for the poorest groups. But judging by goodness of fit, the equations in table 1 leave much to be desired. In the sample of developing countries, the estimated equations explain only a quarter of the observed variation in income shares of the lower income groups, and much less than this for the top 20 percent. The R^2 values for the equations estimated from the full sample are much higher; but this is partly because the inclusion of socialist countries in this sample adds substantially to the intercountry variance in income shares, and the dummy variable for these countries then 'explains' most of this added variance. The true relationship between inequality and development must be fairly complex, reflecting the impact of a number of processes of structural change occuring with development. Such a complex relationship obviously cannot be 'reduced' into a relationship with a single explanatory variable. The estimated relationship shown so far is undoubtedly of interest as a possible indicator of the long term behavior of inequality, but it tells us nothing about the specific mechanisms through which development affects the degree of inequality. It is these mechanisms that are of interest, and will be considered next.

Income distribution and economic structure

Our search for the specific mechanisms through which development affects the degree of inequality is necessarily limited by the availability of cross country data on possible explanatory variables. The explanatory variables we were able to use are reported in table 2 (where their relation to per capita GNP is noted). The relationship between income inequality and these different aspects of development was explored by experimenting with alternative combinations of these explanatory variables in explaining cross country variation in the income shares of the different percentile groups.

In general, we find that three aspects of the development process appear to be systematically related to the degree of inequality. These are:

(1) Intersectoral shifts involving a relative decline of the traditional agricultural sector and a parallel shift of population to the urban sector.

Table 2

Explanatory variables used in cross country regressions.

Variables	Correlation coefficient with log of per capita GNP
(1) *Level and pace of development*	
Logarithm of per capita GNP (constant 1971 US$)	1.00
Dummy variable for all developed countries	0.75
Rate of growth of GNP over the past 5–10 years (percentage)	0.03
(2) *Education and human resources*	
Literacy rate (percentage)	0.81
Primary school enrollment rate (percentage)	0.62
Secondary school enrollment rate (percentage)	0.85
(3) *Structure of production*	
Share of agriculture in GDP (percentage)	−0.88
Share of urban population (percentage)	0.83
(4) *Demographic characteristics*	
Total Population	−0.03
Rate of growth of population (percentage)	−0.55
(5) *Government activity*	
Share of government revenue in GDP (percentage)*	−0.24
(6) *Other common variables reflecting structural commonality*	
Dummy variable for Latin American countries	0.01
Dummy variable for Socialist countries	0.12
Gini coefficient for land distribution*	−0.02

*This variable is not available for all countries in the full sample. The correlation coefficient relates to the subsample for which observations are available.

(2) Expansion in the educational and skill characteristics of the population.
(3) The 'demographic transition' involving a reduction in the rate of growth of population.

Inclusion of explanatory variables reflecting these processes in our regression equations substantially improves the goodness of fit obtained, and the estimated relationships also conform to a priori expectations about the impact of these processes upon income inequality.

Table 3 provides an overview of the results obtained by the expanded regression equations which include the most effective of these additional explanatory variables. Equation (a) is a general form applied to all income shares, and includes variables with coefficients that are not always significant. Equation (b) for each income share contains only those variables that are found to be significant in equation (a). Clearly, the expanded equations have greater explanatory power than the equations reported in table 1, in which development was measured solely in terms of per capita GNP. They explain two-thirds to three-fourths of the observed variation in income shares, compared to just over half in the case of the simpler formulation.

Table 3
Inequality and development.

Dependent variable	Estimated coefficients on explanatory variables[a]												
Income shares of:	Constant	Log per capita GNP	[Log per capita GNP]^2	Share of Agriculture in GDP	Share of Urban population in total	Literacy rate	Secondary school enrollment	Population growth rate	Socialist dummy	R^2	F	D.W.[b]	Turning point US$
(1) Top 20 percent													
(a)	−8.711	49.620	−7.975	−0.258	−0.090	−0.094	−0.146	3.611	−9.443	0.75	23.4	1.90	1291
	(0.26)	(2.24)	(2.10)	(2.15)	(1.58)	(2.29)	(2.63)	(4.28)	(3.27)				
(b)	−1.592	43.580	−7.157	−0.225		−0.107	−0.160	3.48	−9.287	0.75	25.7	1.95	1108
	(0.05)	(1.97)	(1.87)	(1.87)		(2.60)	(2.86)	(4.09)	(3.17)				
(2) Middle 40 percent													
(a)	34.27	−5.819	0.977	0.226	0.035	0.045	0.115	−2.448	0.751	0.70	18.0	1.82	
	(1.57)	(0.40)	(0.39)	(2.86)	(0.93)	(1.68)	(3.14)	(4.43)	(0.40)				
(b)	30.46			0.172			0.154	−2.51		0.70	45.8	1.88	
	(14.63)			(4.08)			(6.49)	(5.48)					
(3) Lowest 60 percent													
(a)	105.3	−57.70	9.212	0.115	0.078	0.080	0.084	−2.50	10.43	0.74	22.47	1.96	1355
	(4.02)	(3.30)	(3.08)	(1.22)	(1.72)	(2.45)	(1.91)	(3.77)	(4.59)				
(b)	126.3	−68.470	10.68		0.068	0.076	0.089	−2.425	11.05	0.74	25.2	1.92	1605
	(6.38)	(4.53)	(3.88)		(1.53)	(2.35)	(2.03)	(3.65)	(4.96)				
(4) Lowest 40 percent													
(a)	74.500	−43.850	7.009	0.032	0.055	0.049	0.031	−1.161	8.702	0.68	16.48	2.06	1343
	(4.01)	(3.54)	(3.30)	(0.48)	(1.73)	(2.13)	(1.0)	(2.47)	(5.40)				
(b)	85.660	−51.440	8.41		0.057	0.056		−1.155	9.184	0.68	22.0	2.04	1144
	(6.59)	(5.29)	(4.96)		(1.85)	(2.61)		(2.48)	(5.98)				
(5) Lowest 20 percent													
(a)	35.110	−21.24	3.337	−0.004	0.027	0.021	0.001	−0.333	4.697	0.58	11.37	1.83	1522
	(3.73)	(3.38)	(3.10)	(0.12)	(1.67)	(1.82)	(0.08)	(1.40)	(5.75)				
(b)	34.520	−21.00	3.315		0.027	0.022		−0.336	4.685	0.60	15.7	1.83	1454
	(5.31)	(4.32)	(3.91)		(1.77)	(2.01)		(1.44)	(6.10)				

[a] t-statistics in parentheses.
[b] In estimating these equations the observations were entered in ascending order of per capita GNP. The Durbin-Watson statistic therefore gives some idea of the pattern of residuals with this ordering. The lack of serial correlation of residuals in the above equations provides some reassurance that the quadratic formulation captures the underlying nonlinearity reasonably well.

A general problem in exploring these relationships is that the explanatory variables used to reflect different aspects of development are all highly correlated with per capita GNP (see table 2) and this makes it difficult to attribute observed associations in a particular equation to the impact of one or the other variable. There is no fully satisfactory solution to this problem. The approach we have adopted is to examine the relationship with each variable under alternative specifications of the regression equation in order to determine which relationships appear more stable in the face of inclusion and exclusion of other explanatory variables.

Intersectoral shifts. Shifts occuring with development have long been recognized as a possible mechanism through which the process of development affects inequality. This was first pointed out by Kuznets (1963), who argued that development typically involves accelerated growth in the high income nonagricultural sectors, which slowly absorb population from the low income, relatively stagnant agricultural sector. Such a process would lead to an increase in relative inequality in the early stages of development and, under certain conditions, would generate precisely the U-shaped behavior discussed above.

It is easily shown that, with certain restrictive assumptions, the intersectoral shifts described will generate a U-shaped pattern in

inequality. Such assumptions, of constant inequality within sectors and equal growth rates in sectoral incomes, are obviously unrealistic. In fact, we would expect both the degree of inequality within sectors and mean income differences between sectors to change systematically with development. Interestingly, there are plausible reasons for supposing that these changes might reinforce the U-shaped pattern in overall inequality changing through time. For one thing, inequality in the urban sector may itself follow a U-shaped pattern. It may increase initially, as accelerated economic growth creates a strong demand for skilled labor in the face of acute scarcities, with the result that skill differentials expand. In the later stages, we can expect urban income to become more equal as labor skills improve and become more widely dispersed in the population, leading to both an increase in the wage share in total income as well as greater equality in the distribution of wage income.

The ratio of mean incomes between sectors may also follow a U-shaped pattern, with intersectoral differences widening in the early stages as scarce capital and other resources are pre-empted by the modern (and typically privileged) urban sector, to the detriment of productivity and income levels in the traditional sector. These differentials can be expected to narrow in the later stages of development for two reasons. Firstly, as capital becomes less scarce, more resources are likely to be made available to improve productivity in the low income sectors. Secondly, as the size of the modern sector increases in the later stages of development, its continued expansion has a proportionately larger impact on reducing the pressure of population in the low income sector. Both factors lead to an accelerated increase in productivity in the traditional sector and the later stages of development, and can be expected to reduce income differentials between sectors.

A systematic exploration of the impact of intersectoral shifts on inequality calls for data on inequality within each sector, sectoral mean incomes, and sectoral population shares. In the absence of such data we have used two explanatory variables which capture some aspects of the process. These are the share of agriculture in GDP, which declines with development as the non-agricultural sector grows at an accelerated rate; and the share of the urban population, which can be expected to rise as population shifts away from the traditional agricultural sector. The two variables are obviously closely related to one another but they do reflect somewhat different aspects of the same process. The share of agriculture in the GDP reflects the extent to which the income-generating capacity of the economy has shifted into nonagricultural activity, while the share of the urban population reflects the extent to which this shift has been accompanied by increased absorption of population into the nonagricultural sectors.

Our general results on the impact of structural shifts on inequality can be summarized with reference to the results reported in table 3 [less significant and ancillary findings omitted].

(1) We find that the share of agriculture in GDP and the urban share of total population are both significantly related to the pattern of income inequality, but their effects on income shares of different groups are not identical. The share of agriculture in GDP is not significantly related to the income shares of the lowest groups, but it is positively related to the income shares of the middle groups and negatively related to the income share of the top 20 percent (equations (2b) and (1b) in table 3). By contrast, the share of the urban population in the total has no significant effect on the income share of the middle group, but is significantly and positively associated with the income shares of the lowest groups and negatively associated with the income shares of the top 20 percent (equations (3b), (4b), and (1b) in table 3).

(2) These results point to an interesting asymmetry in the distributional impact of the intersectoral shifts that occur with development. As the share of agriculture in GDP declines with development, there appears to be a relative shift of income away from the middle group and towards the upper groups. Alongside this disequalizing process, however, development also generates a shift of population to the modern or urban sectors. According to the cross section results, this latter process appears to favor the lowest income groups at the expense of the rich.

The proposition that increasing urbanization may raise the income shares of the lowest income groups is consistent with a priori expectation. Given the dualistic nature of the development process, a higher rate of urbanization, other things being the same, reflects a wider access to productive employment opportunities in the expanding nontraditional sector, and a correspondingly lower pressure of population in the rural areas. Both forces can be expected to operate in favor of the lower income groups.

The observed disequalizing impact of the decline in the share of agriculture in GDP in terms of a shift from the middle income groups to the top is less easily explained. One possibility is that as the relative size of agricultural activity diminishes, compared to nonagricultural activity, there is a shift towards greater concentration of income and wealth because the nonagricultural sector typically promotes larger size production units for both institutional and technological reasons. A shift from small to large scale production can be expected to generate an increased concentration of income in upper groups at the expense of the middle. We can also speculate that the observed adverse effect on the middle groups is due to the fact that the decline in the relative importance of agriculture probably has its strongest impact on the small and middle-sized land-holding cultivators who

dominate the middle income groups in early stages of development. The slower growth rate in agriculture implies a slower growth in income for these groups, which is in turn reflected in a declining income share of the middle income group in the economy. The difficulty with this argument is that it implies that the poorest rural groups (e.g. landless laborers, artisans, etc.) may also be adversely affected by the slower growth of agriculture, and this should be reflected in a positive relationship between the share of agriculture in GDP and income shares of the lowest 40 percent or lowest 20 percent. Our results provide no evidence of such a relationship. The equations in table 3 suggest that the income share of the poorest groups are affected by the level of development as measured by per capita GNP, but not by the relative importance of agriculture at a given level of development. One possible explanation is that the poorer, landless groups are relatively more mobile than landowning cultivators and are more willing to shift from agriculture into unskilled employment in urban areas, so that their income share is less affected by the relative size of agricultural production.

Education and labor skills. Improvements in the educational characteristics and skill endowments of the labor force provide another mechanism through which development affects inequality. The usual argument is that this mechanism operates to promote income equality in the long run. The reasons underlying this optimism are worth reviewing before considering our empirical results.

The central assumption underlying this view is that there is substantial scope for substituting skilled for unskilled labor in the production process, particularly in a dynamic context, without a decline in the marginal productivity in the former. This view of production and technological change, combined with the conventional marginal productivity theory of factor rewards, implies that a more skilled labor force will produce a shift from low paid, unskilled employment to higher paid, skilled employment. This shift, it is argued, produces higher labor incomes, a reduction in skill differentials, and an increase in the share of wages in total output. This mechanism, combined with economic policies that do not discriminate against labor-using and skill intensive production sectors, is often described as the key to the success of countries such as Taiwan and Korea in achieving a rapid rate of development together with high growth rates of employment and relatively equal income distribution.

(Note that the assumption that a greater supply of skilled labor will not produce a sharp decline in its marginal product is obviously crucial to this sequence. Otherwise, skill upgrading will not have much effect upon total output, and while it may reduce relative wage differentials it may also reduce the share of labor in total income thus contributing to an increase in overall inequality. Indeed, in these circumstances it is even likely that skill differentials will not narrow because

of the resistance of organized labor, and the result will be either open unemployment of skilled labor or displacement of unskilled labor by skilled labor in the unorganized sectors. The existence of "over-educated" manpower in many developing countries may reflect just such a phenomenon. Proponents of the importance of education are usually undismayed by this phenomenon and explain it away as an expansion in the wrong kind of education.)

In addition to the technological assumptions about factor productivity, there is also the argument that skill-intensive development patterns are less prone to income concentration than capital intensive patterns. This is because of the peculiar characteristic of human capital--unlike physical capital--that expansion in the stock of human capital in the economy necessarily involves dispersion across a wider population. There is a limit beyond which human capital cannot be accumulated in a single person, and at any rate it cannot be bequeathed across generations in the same manner as physical capital. Both factors, it is argued, combine to generate strong pressures toward equality in income distribution as the human resource endowment expands with development.

The available data permit us to examine the education-inequality relationship in terms of three explanatory variables which provide crude approximations to the level of human resource development--the literacy rate, the primary school enrollment ratio and the secondary school enrollment ratio. Because of the high correlation among these variables, it is necessary to be somewhat selective in our choice of explanatory variables. We have chosen the literacy rate as a measure of the basic education level of the stock of the population, and the secondary school enrollment rate as a measure of the degree of educational achievement beyond this basic level. Two points about the exclusion of the primary school enrollment rate are worth noting. First, the literacy rate provides us with a better measure of the basic education level, being a measure of the stock of working adults rather than of future additions to the stock. Secondly, we observe in our sample that there is relatively little variation in the primary school enrollment rate across countries beyond the middle level of development when fairly high enrollment ratios are achieved in most countries, which makes it less attractive as an explanatory variable. The results obtained can be summarized as follows:

(1) There is clear evidence that education is significantly and positively correlated with equality. When the two education variables chosen--the literacy rate and the secondary school enrollment rate--are entered in the regression equations without per capita GNP (equations omitted here), we find that the secondary schooling variable is significantly associated with shifts in income from the top 20 percent to all other groups except the lowest 20 percent. The literacy rate is not significant in any of the equations. When these variables are

included together with the quadratic in per capita GNP, however, the pattern changes in important respects. The secondary schooling variable retains its positive impact on the middle groups, but the literacy rate variable now has a positive impact on the income shares of the three lowest groups. (It is tempting to conclude that the relationship thus revealed reflects the true impact of literacy on inequality, which was previously swamped by the bias introduced by the exclusion of per capita GNP.) This basic pattern remains unchanged when the equations are expanded to include other explanatory variables--see table 3.

(2) The positive impact of education on relative equality appears to be quantitatively fairly substantial. For example, an increase in the literacy rate from 10 percent to 60 percent is associated with a 2.8 percentage point increase in the share of the lowest 40 percent. This should be compared to an average share for this group of about 16 percent at low levels of development. Similarly, an increase in secondary school enrollment from 10 percent to 40 percent is associated with an increase of 4.6 percentage points in the income share of the middle 40 percent, compared to an average share of 34 percent for this group at low levels of development.

(3) The fact that the secondary schooling variable benefits the middle groups while the literacy rate benefits the lower groups calls for some explanation. The most plausible explanation is in terms of the likely beneficiaries of expansion in secondary schooling and expansion in literacy in our sample. In general, the observed variation in secondary school enrollment (between 5 and 40 percent for most developing countries) is not such that the benefits of expansion in enrollment are likely to have reached the poorer groups. Access to secondary schooling almost certainly expands from the top downwards, so that the lower income groups are excluded from secondary schooling in the observed range for most countries in our sample. By contrast, the variation in literacy rates observed in our sample (between 10 to 80 percent for most developing countries) is such that the observed expansion in literacy clearly does reach the lowest groups where it occurs.

(4) It is interesting to note that in the case of each of the education variables, the income share of the relevant beneficiary group expands at the expense of the income share of the top 20 percent. This can be said to be an unambiguous improvement from the welfare point of view.

These results are again broadly in line with earlier cross section studies--Adelman and Morris, Chenery and Syrquin--in that they testify to the close relationship between the process of education and skill improvement, which occurs with development, and the increase in relative equality. As we have seen, there are persuasive reasons for arguing that the correlation reflects an important causal process,

although the argument does depend upon some fairly crucial assumptions which may not hold in a number of circumstances. Skeptics will also want to point out that the observed correlation may even reflect the reverse direction of causation: educational levels may be determined by the degree of inequality. The cross section data are also consistent with this hypothesis, of course.

Population growth and inequality. The reasons for expecting a particular relationship between income inequality and the rate of growth of population are much less clear than the reasons for expecting the relationships discussed above. For one thing, our understanding of the role of population growth in the development process is fairly limited. Most of the debate in this area has been focussed on the relationship between population growth and the pace of development, while its impact on the degree of inequality has received less attention. In these circumstances, it is appropriate to begin with observed cross country experience and then consider how far we have a theory to explain it.

Our estimated results unambiguously show high growth rates of population to be systematically associated with greater income inequality. As shown in table 3, the rate of growth of population has a significant positive impact on the income shares of the top 20 percent, and a significantly negative impact on the income shares of all other groups (except the lowest 20 percent, for which group the coefficient on the population variable is negative but not significant). This general pattern remains valid when the regressions are run with different combinations of other explanatory variables, and also with the reduced sample of developing countries only. In interpreting this result, it is important to note that the relationship identified above holds after controlling for other explanatory variables such as per capita GNP. Therefore, we need to ask ourselves why an economy with faster population growth would show greater inequality when it reaches a given level of per capita GNP than another with a slower growth of population observed at the same level of development. The literature suggests two possibilities, neither of which has been fully explored.

(1) Perhaps the most important link between population growth and income inequality is provided by the fact that different income groups grow at different rates, with the lower income groups typically experiencing a faster natural rate of increase in population. Although we have not allowed explicitly for intergroup differences in population growth (data on this subject are simply not available) it is arguable that high growth rates in total population reflect greater differentials in population growth among income groups, which in turn generate greater inequality. The argument can be summarized as follows.

It is well known that the process of development produces a "demographic transition". Suppose that this transition takes the form of a reduction in the natural rate of population growth of each group as per capita income in the group rises, and there is a flattening out of this response at high income levels. In that case, declines in the rate of growth of total population will occur with development as the various groups slide along this curve, and the flattening of the curve implies that this process will eventually produce a narrowing of intergroup differentials in population growth. The argument can be carried even further if we allow for the fact that high population growth rates in some low income countries reflect an initial acceleration in population growth as a result of lower mortality, after which they can be expected to go through a "demographic transition" as birth rates decline. It is reasonable to assume that this type of acceleration in population growth occurs mainly in the low income groups where the mortality rate is highest. These factors suggest that countries with high growth rates of population probably suffer from larger intergroup differentials in population growth compared to countries with low growth rates of population. It follows that in countries with high growth rates of population, per capita income of the poorer groups will grow more slowly compared to per capita income of the rich, leading to higher inequality at given levels of per capita GNP.

(2) A second link between population growth and inequality is suggested by the fact that higher growth rates of population imply greater pressure of labor supply on other productive factors, with a consequent fall in the share of labor in total output. This is especially so in the presence of fixed factors such as land, which are likely to be particularly important in developing countries. A higher population density generated by faster population growth is likely to produce a higher rental share, which in turn generates greater inequality given the typically concentrated pattern of land ownership. A similar argument can be advanced in the case of capital as a productive factor. It has been argued that high growth rates of population lead to higher dependency burdens, which reduce the flow of private savings, and also place a larger claim on scarce public resources for nonproductive public service investment. [See N. Leff in Development Digest, January 1972, p. 23.] Both factors tend to lower the ratio of productive capital to labor. If we accept the conjecture that economies with a faster rate of growth of population have lower equilibrium capital/labor ratios at any level of development, it is very likely that they will also have lower labor shares.

Socialist countries. A consistent finding in all the equations estimated is that the six socialist countries in the sample display substantially greater equality than is predicted by the cross country regression line. The coefficient on the dummy variable for these countries is significantly negative in all the equations explaining income shares of the top 20 percent and it is significantly positive for all other groups. This is precisely what one would expect, given the

absence of the disequalizing effect of income from property (i. e. land and capital), which is typically highly concentrated.

It is also of interest to consider how the absolute size of the coefficient on the dummy variable changes as we allow explicitly for the impact of particular aspects of development. Taking the various equations explaining the income share of the lowest 40 percent, for example, we find that the coefficient on the dummy variable for socialist countries is about 12.0 in the case of the basic equation reported in table 1. It drops to 9.7 when the educational variables are included, and is further reduced to 8.7 by the inclusion of all the other explanatory variables in the expanded equations reported in table 3. Thus a part of the much greater equality of the socialist countries observed in the sample may be due to the fact that in these countries, the progress made in expanding education levels and reducing the rate of growth of population is much greater than for other countries at their income levels. However, it is clear that even after allowing for these specific factors, the socialist countries display markedly greater equality.

It is appropriate at this point to remind the reader of some caveats. Our equations do not take account of some of the crucial factors determining cross country differences in income inequality, of which two deserve special mention. The most important omission is our inability to examine the role of differences in the concentration in ownership of productive assets, including land. This aspect of economic structure is rightly regarded as a crucial determinant of income inequality, and the greater equality observed in socialist countries testifies to this fact. Countries differ widely in the degree of concentration in productive assets, both in terms of the initial conditions in this respect and in the institutional and policy framework which determines the evolution of concentration patterns over time. Unfortunately, lack of data on patterns of concentration of wealth makes it impossible to quantify this relationship directly for most countries. We have experimented with the Gini coefficient of the distribution of agricultural land, available for about thirty countries, as an explanatory variable; but no significant relationship was identified between this variable and income inequality. This is not really surprising, given that the direct impact on overall inequality will depend upon the share of the rural sector in terms of population and income, which varies substantially among countries.

A second limitation of our exercise is the lack of explicit recognition of the role of the institutional framework in which development takes place. The distribution of income generated by an economic system is ultimately the result of a complex interaction between economic and socio-political forces. For example, the distributional impact of an initial concentration of land depends not merely upon the resulting concentration of "equilibrium" factor incomes, but also on its impact on the equilibrium itself through the dominant

position accorded to landowners in a whole range of transactions. Similarly, improvement in labor incomes and labor shares in total income, occurring with development, depends not only on the upgrading of skills and technological factor productivities as discussed above, but also on the growth of labor power through social and political institutions. These socio-political factors are not easily quantified on even an ordinal scale, let alone the cardinal scale needed for regression analysis. Apart from the introduction of a dummy variable for socialist countries, we have made no allowance for subtler differences in socio-political structure. We did attempt to test for the effect of the scale of government activity, as measured by the ratio of tax revenues to GNP, but no significant relationship was discernible.

Relative inequality, absolute poverty and development

Although income inequality among countries is related to other variables measuring aspects of development, an important feature of these results is that the inclusion of these additional explanatory variables does not swamp the observed relationship between inequality and per capita GNP. The expanded equations reported in table 3 show a clear U-shaped pattern with respect to per capita GNP, with the coefficients on the two terms of the quadratic being significant and retaining the signs they had in the table 1 equations. We turn now to the implications of these results for the long-term path of inequality, and the welfare implications of this path.

The U-shaped curve revisited. The first point to note about the expanded equations reported in table 3 is that, although they confirm the U-shaped pattern, the magnitudes of the coefficients on the quadratic terms are sufficiently altered to change the curvature of the extimated U shape. The U-shaped curve in the expanded equation for the income share of the lowest 40 percent is substantially flattened out in the later phase of higher income levels when inequality declines. The earlier phase of sharply increasing inequality remains relatively unchanged; but the subsequent decline in inequality is greatly slowed down. The same pattern of a flattening in the inequality reductions in the later phases of development is repeated in the case of the income shares of the lowest 60 percent and the lowest 20 percent, and there is a corresponding flattening of the inverted U shape for the top 20 percent also. In all cases, the turning point is shifted substantially further out to higher per capita GNP levels (compare results in table 3 and table 1).

The change in the estimated U shape suggests the following hypothesis for further study. The reduction in inequality observed in the later phases of development appears to be associated with a number of particular processes occurring with development reflected in the additional variables, such as the increasing absorption of labor in the relatively high-income modern sector, the expansion in education and the

improvement in human resources, and the reduction in population growth rates. Once we allow explicitly for the operation of these processes (as we have done in the expanded quotations) the ascending phase of the U-shaped curve is almost completely damped. By contrast, we have not been able to isolate particular processes occurring with development which underlie the initial phase in which relative inequality increases. Of the various relationships discussed earlier, only the process of a declining share of agriculture in GDP is associated with increasing inequality, a shift from the middle group to the top, leaving the lower income groups unaffected. If we focus on the income shares of the lowest 40 percent and the lowest 20 percent, none of the variables with which we have experimented help to explain the decreasing shares of these groups.

The absolute impoverishment hypothesis. A prolonged decline in income shares of lower income groups in the early stages of development has important welfare implications. It means that the poor benefit from development much less than the rich. Furthermore, Adelman and Morris have argued that developing countries face the prospect not just of increasing relative inequality but of prolonged absolute impoverishment for the lower income groups. This view needs to be examined carefully.

The proposition that development may lead to absolute impoverishment of the poorer groups cannot be ruled out a priori. Such an outcome may result from the erosion of traditional economic structures as a consequence of the expansion of the modern sector. An aggressively expanding, technologically advanced modern sector, competing against the traditional sector for markets and resources, and benefiting in this competition from a favorable bias in government policies due to an entrenched position in the institutional and political context, could well generate an absolute decline in incomes of the poor. History provides numerous instances of the operation of such processes--e. g. the European enclosure movements.

Against this bleak view of the development process, there is another explanation of the observed increase in relative inequality which is somewhat less pessimistic. On this view, increasing relative inequality is not due to absolute impoverishment but to unequal benefits from growth. Thus if economic expansion occurs in sectors and segments in which the initial benefits accrue to the upper income groups, and if these groups have relatively weak income linkages with the poorer income groups, we would expect income shares of the poorer groups to decline without any decline in their absolute incomes. This disequalizing impact is not restricted to the case in which opportunities for economic expansion are limited to upper income groups. It can be shown that if opportunities for economic expansion take a form in which individuals in all income groups have prospects for the same percentage increase in income, but in all groups only a given percentage of the population (also constant across groups) can actually

achieve this, it may still be the case that income shares of the poorer groups will decline.

The differences between these two views of what lies behind the observed increase in relative inequality are crucial. In the one case we assume that the disruption of low income traditional economic activities is in some sense a necessary consequence (on some views such a sacrifice is even an essential pre-condition!) for the growth of the modern sector. In the other case, the problem is not seen as arising from a necessary contradiction.

Choosing between these views, or finding an appropriate mix of these views, is ultimately an empirical issue. Cross section analysis should not be used to derive general pronouncements to be applied to all cases; but it can help to document the "stylized facts" of cross country experience. The data permit two different tests of the absolute impoverishment hypothesis. The first consists of using the estimated income shares of the lower income groups from the regression equations described above to calculate the per capita absolute income of these groups at different levels of per capita GNP. The second test consists of calculating the average absolute income of the poorer groups for each country from the actual income shares, and then estimating a cross country relationship between this measure of absolute income of the poor and the level of development. We find that both tests reject the hypothesis that the process of development produces impoverishment in absolute terms.

Table 4 presents estimates of average incomes of the lowest 60 percent, the lowest 40 percent, and the lowest 20 percent at different levels of development based on income shares for these groups predicted by equations (3b), (4b) and (5b), for the full sample of countries (table 3), and from the same equations estimated for the reduced sample of developing countries only. In all cases, the estimated average absolute income of these groups increases with per capita GNP.

These results are further supported by the attempt to estimate regression equations using the logarithm of average absolute incomes of the three lower income groups as the dependent variable. The explanatory variables are the same as those used to explain income shares in the expanded equation in table 3 and include a quadratic in logarithm of per capita GNP in order to test for the existence of a phase of absolute impoverishment. We find that although the coefficient on the first term in the quadratic is negative in the equations for the lowest 40 percent and the lowest 20 percent, it is not significant in either case. In any case, these coefficients imply no decline in absolute income over the relevant range.

We conclude that while the cross country evidence points to unequal benefits from growth, it does not support the hypothesis of a prolonged decline in absolute incomes for the poor as development

Table 4

Estimated average absolute income levels of low income groups.[a]

Per capita GNP in US$	Lowest 60 percent		Lowest 40 percent		Lowest 20 percent	
	Full sample	Developing countries	Full sample	Developing countries	Full sample	Developing countries
75	51.6	45.5	42.0	37.8	32.6	27.7
100	63.2	55.4	50.2	42.0	38.3	31.7
200	103.8	89.0	77.3	63.7	56.3	44.9
300	140.3	118.2	101.2	84.6	70.8	57.5
400	175.2	145.5	124.0	106.4	84.1	71.1
500	209.4	171.8	146.7	129.6	96.8	86.3
600	243.4	197.6	169.6	154.4	109.4	103.1
700	277.4	223.1	193.0	180.7	122.1	121.6
800	311.6	248.5	217.0	209.1	135.0	141.6
900	346.0	273.9	241.6	238.9	148.2	163.3
1000	380.7	299.4	266.9	270.2	161.8	186.5
1500	560.0		403.6		235.7	
3000	1158.9		909.1		519.1	

[a]The figures in the first column for each income group are based on income shares predicted by eqs. (3b), (4b) and (4c) from table 3, and the figures in the second column are based on income shares predicted by the same equation estimated from the reduced sample of developing countries only.

proceeds. Of course, we should be careful in interpreting this result. The percentile groups we have defined are very large, and increases in average incomes for such broadly defined groups may hide significant declines in income for particular socio-economic groups which are offset by income growth for other groups. Such offsetting changes may be an important aspect of the dynamics of income distribution in developing countries, but they cannot be captured by the traditional approach to distribution which focusses on income shares of ordered percentile groups. A systematic treatment of the absolute impoverishment hypothesis calls for examination of the trends in per capita income in particular socio-economic groups in particular countries. But it will be some time before reliable time series data suitable for such studies become available, and until then the results of cross section analysis will be worth noting.

Growth and inequality: The short-term relationship

Thus far, our analysis has focussed on what are essentially long-term relationships between inequality and development. The worsening in relative inequality observed in our cross-country data occurs over the phase of development presented by the transition from per capita GNP levels of US$ 75 to per capita GNP levels of around US$ 750. For an economy experiencing growth in per capita GNP at the rate of 2.5 per cent per year, this transition would take about a hundred years. While long-term relationships are of considerable

interest, it is important to note that many of the debates in this area have focussed on much more short-term impacts.

The importance of making a distinction between the long term relationship between inequality and levels of development on the one hand, and the short-term relationship between inequality and growth on the other, is not always clearly recognized. For example, it has been suggested that growth rates in some of the developing countries observed over comparatively short periods--e.g. Brazil between 1960 and 1970--have led to a marked increase in income inequality. To some extent, the long-term relationship discussed above would produce precisely such an outcome: a higher rate of growth observed over a given period raises the level of development above what it would otherwise be, and this in turn affects inequality. However, the debate on this issue has a somewhat different flavor. There is a definite suspicion that there are short-run mechanisms which are quite distinct from any structural or long-term factors, and which generate greater inequality as a direct consequence of faster growth. This raises the question of whether the degree of inequality may be affected not only by the level of development but also by the speed at which this level is achieved.

A plausible reason for the existence of such a relationship may be found in a number of short-term pressures associated with high growth rates. For example, the existence of lags in factor mobility between regions or sectors will ensure that, as opportunities for accelerated growth arise in particular regions or sectors, economic expansion creates factor market disequilibria which may generate significant income differentials. Such disequilibria are likely to be more severe in a high-growth situation than in a more stable low-growth situation. Income differentials generated through this mechanism must be clearly distinguished from those which reflect long-term structural factors, such as the endowment of labor skills of the economy as a whole.

The cross country data permit only a crude test for the existence of a short-term relationship of this type. We can include the rate of growth of GDP for each country over the ten years preceding the point at which the distribution is measured as an additional explanatory variable in our regression equations, and see whether (other things being the same) faster growing countries display greater inequality. The results obtained from this exercise reject the hypothesis that a faster rate of growth leads to greater inequality. The coefficient on the growth rate variable remained insignificant in a number of experiments with alternative combinations of explanatory variables, including some in which the per capita GNP variable was not included.

This absence of any significant relationship between inequality and the ten-year rate of growth is a potentially important aspect of observable cross-country experience. One interpretation is that, while

there may be a secular time path for inequality which developing countries must traverse and which contains a phase of increasing inequality, there is at least no evidence that countries which traverse this path at a fast pace are worse off at the same level of development than countries which traverse it at a slower pace. Such a proposition, if accepted, has dramatic policy implications. It suggests that policy-makers may be best advised to think of the rate of growth as determining essentially the speed of transition through the different phases of development and inequality: higher growth rates accelerate this transition but without necessarily generating greater inequality than can be expected given the structural characteristics of the economy at each level of development.

It would be naive to pretend that so important a conclusion can be firmly established on the flimsy basis of the lack of an observable relationship between inequality and the rate of growth. Precisely because of its importance, however, it is worth examining the results more carefully to extract a legitimate interpretation. Our methodology does not permit us to go beyond the simple measurement of rates of growth to examine differences in the type of growth achieved in different situations. Since it is precisely these differences which will determine the distributional impact of growth, we cannot hope to provide any insight into this question by focussing solely on the levels of growth achieved. But if we cannot deny that certain types of high growth processes lead to greater inequality than can be structurally expected, we can at least assert that all fast growers do not systematically display this pattern. If there are countries in which this is true, there are others which display the opposite pattern, so that no systematic pattern emerges across countries. Such time series evidence as is available tends to support this point of view. The experience of Brazil, where the high growth was accompanied by worsening relative inequality, can be contrasted with the experience of Taiwan, where substantial growth has taken place with an actual reduction in income inequality.

Recognizing this diversity of country experience is perhaps the most important lesson to be learned from the data. At the very least, it shifts attention from an unquestioning suspicion of high growth rates as such towards an examination of the particular nature of growth in different countries, and the implications of different types of growth for inequality.

Conclusions

The objective of this paper is primarily exploratory, given the limitations of cross country analysis. The results presented above are best viewed as a useful documentation of empirical regularities; they can also be viewed as providing some clues to the mechanisms

through which the development process affects the degree of inequality, but they can be no more than clues. Subject to these limitations, our cross country results can be summarized as follows.

1) There is strong support for the proposition that relative inequality increases substantially in the early stages of development, with a reversal of this tendency in the later stages. This proposition holds whether we restrict the sample to developing countries or expand it to include developed and socialist countries. Furthermore, it appears that the process is most prolonged for the poorest group.

2) There are a number of processes occurring in the course of development which are correlated with income inequality and which can plausibly be interpreted as causal. These are intersectoral shifts in the structure of production, expansion in educational attainment and skill level of the labor force, and reduction in the rate of growth of population. The operation of these processes appears to explain some of the equalization in income distribution observed in the later stages of development, but they do not serve to explain the marked increases in inequality observed in the earlier stages.

3) The cross section results do not support the stronger hypothesis that the increase in relative inequality reflects a prolonged absolute impoverishment of large sections of the population in the course of development. The cross country pattern shows average absolute incomes of the lower percentile groups rising as per capita GNP rises, although slower than for upper income groups.

4) Finally, the cross section results do not support the view that a faster medium-term rate of growth is systematically associated with higher inequality than can be expected at a given stage of development.

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